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AMATEUR MOTOR BUILDING.

The article on amateur motor building, in another column, will be found of interest by those who have the time and opportunity to indulge in the very profitable, from an educational standpoint, pleasure of constructing amateur apparatus. The actual construction of such a model will convey a better idea of the technical principles concerned than a small library of books, and in this case the maker will have the satisfaction of possessing, when completed, a motor of good efficiency, which can be utilized for a fan or for experimental purposes. The directions given are so minute that there should be no difficulty in any one carrying them out, whether with respect to the mechanical construction or the electrical details, which latter will be given in the next section of the article.

ELECTRIC RAILWAY NETWORKS.

Every few months one or more of the New York dailies has an article of some length on New Jersey networks of electric railways, all of which almost seem to be written from the same original copy. Sometimes rumors in regard to a network from Camden approaching to connect with one in Northern New Jersey are elaborated, and the impression likely to be received by the lay reader is that there is something both wonderful and mysterious in these "network" schemes. As far as we can learn, however, towns between which the traffic is likely to be profitable have been connected by electric railways, and the only significance of "networks" is that these lines, on a map, may present such an appearance. If the traffic between towns north of Camden and south of Jersey City is likely to be large enough to justify the construction of lines, they will probably some time meet at Trenton, or some other place, and then we will have what might be called a network system between those extremes, but it does not seem that this implies any strange development of electric traction.

THE ORIGIN OF UPPER HARMONICS.

In another column we print an abstract of the valuable paper read by Dr. Pupin at the Philadelphia meeting of the American Institute of Electrical Engineers, in which, however, only the conclusions are given. Those who would like to know the details of the beautiful method of resonance analysis employed are referred to the original in the *Transactions* of the Institute. The paper has an important practical bearing, for it clearly shows how the presence of the upper harmonics accounts for rupture of insulation of alternating machines, and it is pointed out that lines should be constructed in such a way that conditions favoring resonance with the frequency of the fundamental, or with one of its odd upper harmonics, will seldom occur, or, when they do occur, there will be no resonant rise of potential capable of doing damage. To the same end, slotted armatures and armatures with projecting pole pieces should be avoided, and the magnetization kept as low as possible. Another conclusion of interest is that hysteresis will not, as has been claimed, account for the abrupt cyclic changes which may be the cause of the upper harmonics. The resonance analysis of a rotary field, described in the paper, proves that rotary magnetic fields, if produced by reasonably well constructed machines, are not accompanied by fluctuations in their intensity, which should definitely settle a question which had no reason for its existence.

THEORETICAL VS. PRACTICAL ELECTRICITY.

We have frequently referred in these columns to the dubious advantage of a technical education, in which the teaching of principles is subordinated to purely practical training, and our views receive another confirmation in some remarks by Prof. Ostwald in an introduction to a paper to which we quote elsewhere. He refers

to the fact that the bulk of benzol made in England is exported to Germany, where it serves for the preparation of colors, perfumes and drugs, and then asks the cause that leads to another country obtaining thus the greater share of a profit, all of which might be retained in England where the raw material is produced. The answer he found during a visit to that country, where he learned that the English student has too great a belief in the value of "practical" subjects to waste time in learning pure chemistry. Wishing to become a technically trained dyer, he learns dyeing instead of the chemical principles upon which dyeing depends, and the natural result is that at the first notable departure from the art of dyeing, as he learned it, he is utterly at a loss, and has to begin learning new empirical methods, instead of applying that general knowledge which the technical man, who has studied chemistry before dyeing, has fully acquired. The Professor states that the secret of German industrial success is that Germans have grasped the fact that science is the best practice. That this is true with respect to chemistry there is abundant evidence in the fact that Germany, which pays immeasurably more attention to the teaching and investigation of chemical theory than any other country, also controls the chemical trade of the world, while her chemical graduates find profitable employment the world over.

ELECTRO-DYNAMIC MACHINERY.

Under the above caption we begin in this issue the publication of a series of articles by Houston and Kennelly, in which will be considered the principles underlying the construction and use of apparatus for the production, distribution, utilization and measurement of electrical energy. This series of articles will, we think, be one of the most valuable to the student of any treatise of the kind that has yet appeared, not only from the exceedingly clear manner in which it is written, but from the logical sequence of the subjects, the numerical examples based upon practical data and used as illustrations, and the fact that it will be up to date in all the matters treated. The series will lack a common fault of much technical writing, which too often has no perspective, treating some subjects at much greater length than necessary, while others of importance are passed over, mere whims often appearing to have dictated the choice and arrangement of matter, rather than logical considera tions. No attempt will be made in these articles to treat of the actual construction of machines and apparatus, which is a subject that would be out of place where the object is the development of general principles, whose application in most cases is an engineering question in which commercial and other considerations frequently demand notable modifications. The modern tendency is to give an increasing importance to the study of principles, and that this is based upon sound wisdom cannot be denied. The practice of the constructive branches of a profession consists largely, as intimated before, in compromises between conflicting principles, or in modifications to suit given conditions. In other words, principles are the raw material which have to be worked and fitted to meet the requirements of practice. As a consequence, to be successful, one should have a thorough knowledge of the elements he is thus required to deal with, or otherwise he becomes helpless when a new set of conditions presents itself. The object of this series is to teach these underlying elements of the profession of the electrical engineer; not, however, in the language of the mathematician and the physicist, as usually attempted, but in the terms employed by the engineer.

ELECTRO-CHEMISTRY.

In the Digest will be found an abstract of an important German paper, by Prof. Ostwald, in which it is pointed out that electro-chemistry contains possibilities that are startling in their scope. It is asserted that if we had a cell in which electrical energy was produced by the direct oxidation of carbon (not with heat, however), and with an output approaching the theoretical, we would be on the brink of an industrial revolution, compared with which the invention of the steam engine sinks into insignificance. Numerically, as a pound of carbon contains 14,000 heat units, this is equivalent to saying that 5.4 hourly horse power would be obtained from each pound of carbon used in this way. Prof. Ostwald says that the one essential for such a cell is a suitable electrolyte to interpose between the carbon at one end and the oxygen at the other, which will permit the occurrence of the necessary electrical interactions and itself suffer no permanent change. This, of course, offers us no solution, but it is encouraging to have the problem assume a definite shape with definite requirements pointed out, for then the mind has something tangible upon which to bring its forces to bear. While Prof. Oswald thus indicates the direction in which it will be profitable to explore, he also warns against expecting to obtain notable economy in the production of electricity from coal through the intermediary of heat. An apparatus of this kind would be a thermo-dynamic machine, and therefore subject to the law of thermo-dynamic efficiency, which is that the portion of heat energy utilized cannot be greater than the ratio of the working range of temperature to the extreme absolute temperature. Another problem offered to the electro-chemist is the utilization in a storage battery of a metal having a low electro-chemical equivalent. For example, it is shown that, if aluminium were available for this purpose, the weights of the electrodes could be reduced to one-eleventh of their present amount. It seems to be the opinion of Prof. Ostwald that the fundamental problem in electro-chemistry is that of osmotic pressure, as he asserts that a galvanic cell is nothing more than a machine driven by this pressure. While the origin of osmotic pressure is yet a mystery, its existence has been proved by interposing a septum between two solutions, to one of which it is impervious; a solution of sea water, it is stated, thus gives a pressure of 20 atmospheres. It will be seen that the field of modern electro-chemistry is one with boundless possibilities, and would even appear to offer greater inducements to a young man seeking a professional career than any other branch of electrical science. Unlike most of the other branches, however, it involves a theoretical training of the highest order, and is of all the least likely one to prove profitable to the empiric and dabbler.

Judge Ricks' Decision Sustained.

We referred last week to Judge Dallas' decision in the United States Circuit Court at Lancaster, Pa., sustaining Judge Ricks' opinion in the Buckeye lamp case, and we give below the full text:

"This is a motion for a preliminary injunction to restrain the defendant from using certain electric lamps in alleged violation of the rights of the complainants under what is known as the Edison patent for incandescent lamps. The substantial question is as to the weight which should, upon this application, be accorded to the action of the Circuit Court for the Northern District of Ohio, on certan motions made in that court, for, and to dissolve, preliminary injunctions in suits upon the same patent. In disposing of the motions referred to, Judge Ricks' delivered three opinions, which have been discussed at length by counsel, and attentively read by me; but I do not deem it necessary or advisable to express any opinion of my own upon the subjects with which they deal. It is enough to say that he has decided that the lamps now involved could be lawfully made and sold by the defendant's vendor, and, (quoting authorities) the user of a patented article is not liable as an infringer, where he purchased it of a person who had a legal right to sell it. Nothing is now indicated as to the view which may be taken of this case when considered upon pleadings and proofs, but I am of opinion that, because a preliminary injunction against the maker of these lamps has been refused in the Sixth Circuit, this court should not, upon interlocutory application, enjoin the use of them by a defendant who bought them from that maker. The motion for a preliminary injunction is denied."

The Calculation of Alternating Current Motors.

The interesting serial by Mr. E. Arnold on this subject, which has appeared in these columns during the past year, has been reprinted from the "Elek Zeit.," and in pamphlet form by the Polytechnischen Buchandlung, A. Seydel, Berlin. The treatise is there given in full, and developed considerably beyond the point it reached in our columns. Those who have followed the series will undoubtedly be interested in the complete work.

Fort Wayne vs. General Electric.

The Fort Wayne Electric Corporation, in the New York "World" of last Sunday, has an article of more than a page in length devoted to a history of the company and a description of its works, from which we extract the following account of Mr. R. T. McDonald's recent coup d'etat.

The article states that it was known that for some months Mr. McDonald and President Coffin, of the General Electric, had been considering various forms of a contract to be entered into between their respective companies. Mr. Coffin's idea was to close up the Fort Wayne factories and to manufacture their apparatus at Schenectady. Mr. McDonald had in mind three points he was bound to accomplish, and which he would not compromise on.

The first was that he insisted on the General Electric Company guaranteeing the paper of the Fort Wayne Electric Company which he had indorsed. The second was that the minority stockholders, many of whom were Mr. McDonald's friends, and some of whom had bought Fort Wayne stock on that account, should be fully protected. This it was proposed to do by buying their stock and adding it to the already large, though not controlling, holdings of the General Electric Company. The latter company would then own the Fort Wayne outright, and could do with it as it pleased. Mr. McDonald was willing to leave the company under these circumstances, or he was willing to serve the company for one year without salary. The third point insisted on by Mr. McDonald was that the works at Fort Wayne should be kept running. The pay-roll of the company, as already stated, amounts to about $20,000 a month, and it can be easily seen that this is not a small item to a city the size of Fort Wayne. Mr. McDonald's course throughout these transactions was of a most commendable character. As a business man, he wanted to protect himself; as a friend, he insisted on taking care of the minority stockholders, and as a citizen, he desired to help Fort Wayne all he could.

After numerous contracts had been drafted and considered, the negotiations came to naught, and the matter rested where it had started. Finally, about May 25 last, a meeting was held in New York, at which were present, among others, Mr. Coster, of Drexel, Morgan & Co. and the General Electric Company; President R. T. McDonald and his counsel. At this meeting, Mr. Coster told President McDonald that further negotiation was useless; that the General Electric Company intended to send its own men to Fort Wayne on June 9, when the annual meeting of the Fort Wayne Electric Company's stockholders would be held, and that a Board of Directors satisfactory to the General Electric Company would be elected. This ended the meeting, but it did not take long for President McDonald and his counsel, Mr. Putney, to get their heads together and evolve a scheme to checkmate the General Electric.

With only two weeks before the annual meeting to work in, Mr. McDonald immediately set about getting proxies from his friends among the minority stockholders. He found many such among the ex-officers and employes of the old Thomson-Houston Company. The Thomson-Houston people had come into possession of a large block of stock for the regulator patent, the validity of which they had sustained against Mr. Wood, the Fort Wayne Company's inventor. The par value of Fort Wayne Company's stock was $25 a share. President McDonald owned about 3,000 shares. Among the proxies which he secured were those from ex-President Pevear, of the Thomson-Houston Company, representing 8,000 shares, and from Mr. J. N. Smith, a former director, and at one time the largest stockholder in the Thomson-Houston Company, representing 1,600 shares. Proxies of many other persons were secured. The General Electric Company had about 42 per cent. of the stock. Mr. Coffin had a considerable block, and it was thought that the holdings of the General Electric Company, together with the holdings of others immediately connected with it, would control the election. Thereupon Mr. McDonald made application to the Court for the appointment of receivers.

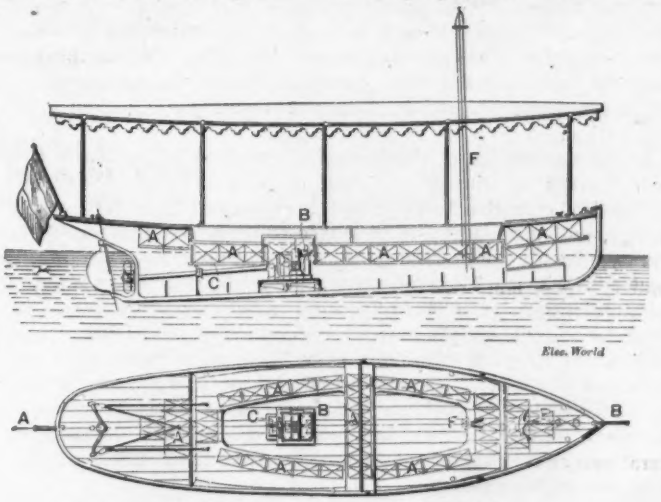
E. J. Hathorne, of Boston, and H. J. Miller, of Fort Wayne, were appointed receivers, and simultaneously came the organization of the Fort Wayne Electric Corporation, which is at present conducting the business. It has made a contract with the receivers to continue the business of the old Fort Wayne Electric Company. Its capital stock is $1,500,000, paid in cash, and the stockholders, who are widely scattered, are practically the holders of the old Fort Wayne stock, with the exception of the General Electric Company. The contract with the receivers has been sanctioned by the courts. The officers of the new Fort Wayne Electric Corporation are: Ronald T. McDonald, president; C. S. Knight, vice-president, and C. C. Miller, secretary and treasurer.

About the first of the year an expert from the General Electric Company went over the books of the Fort Wayne Company and decided that the stock was worth $4.80 per share. The Fort Wayne Company's expert at the same time figured that the stock was worth $6 per share. It is predicted that when the receivers wind up the Fort Wayne Electric Company the assets will be sufficient to meet all the debts and leave a considerable surplus.

New French Electric Launch.

The accompanying illustrations represent an electric launch recently constructed in Paris for use at a pleasure resort on the Mediterranean. The boat is said to be an exceedingly trim little craft, and the trial trips in Paris a few weeks ago are said to have been exceedingly satisfactory from every point of view. The launch is 29 feet 3 inches over all, and it has three feet three inches breadth of beam. Under the seats, which are shown at A in the drawing, and which are designed to accommodate fifteen passengers, is located a battery of 52 accumulators of the Gadot type. The cells are slipped into place at the sides of the seat, the panels being removable. The batteries are contained in wooden boxes carefully sheathed with lead. The tops of the containing cells are closed by lids which press against a rubber gasket. When it is necessary to replenish the liquid it is poured into the cells through openings in the covers which are ordinarily closed by rubber buttons.

The motor, which is installed slightly abaft of amidship, is a Gramme machine of a capacity of 44 amperes at 100 volts. The propeller shaft is driven with a single reduction gear, the speed being reduced in the ratio of 4 to 1. As the armature makes from 1100 to 1200 revolutions per minute, the propeller is driven at the



A FRENCH ELECTRIC LAUNCH.

rate of about 300 revolutions. The pinion on the armature shaft is of rawhide, a material which has been used little for this purpose in France; it is found to be especially useful in this special case, as the noise is found to be much less than if a metal pinion were employed.

The motor is sheltered by a case of varnished wood, and just aft of it sits the operator. He has in front of him the necessary switches, and an ammeter and voltmeter, so that he can at all times keep informed of the state of the accumulators. A rheostat is also provided, but this is seldom used.

To charge the accumulators there has been installed a Gramme dynamo, having an output of 41 amperes and 140 volts. This machine is driven by a two-cylinder vertical gas engine of 20 horse power capacity. The dynamo at the time it charges the 52 cells on the launch also furnishes current to a battery of 56 accumulators which supply 100 16 c.p. lamps arranged about the owner's house.

The charging process occupies about ten hours, and the launch is then ready for a trip of four hours. The average speed, as determined by the tests at Paris, was about 6¼ miles per hour.

The weight of the launch, with its cells, is about 10,800 lbs. This is not great enough to prevent the builders from constructing a frame on wheels, or moving the launch from the waterside to a store house.

Practice vs. Theory.

"The secret of the success of the chemical industry in Germany lies in the fact that it has learned that science is the best practice."
—Dr. Ostwald.

Electro-Dynamic Machinery.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

I. GENERAL PROPERTIES OF DYNAMOS.

1. By electro-dynamic machinery is meant any apparatus for the production, transference, utilization or measurement of energy through the medium of electricity. Electro-dynamic machinery may, therefore, be classified under the following heads:

(1.) Generators, or apparatus for converting mechanical energy into electrical energy.

(2.) Transmission circuits, or apparatus designed to receive, modify and transfer the electrical energy from the generators to the receptive devices.

(3.) Devices for the reception and conversion of electrical energy into some other desired form of energy.

(4.) Devices for the measurement of electrical energy.

Under generating apparatus are included all forms of continuous or alternating current dynamos.

Under transmission circuits are included not only conducting lines or circuits in their various forms, but also the means whereby the electric pressure may be varied in transit, or the capacity of the line altered between the generating and receptive devices. This would, therefore, include not only the circuit conductors proper, but also various types of transformers, either stationary or rotary.

Under receptive devices are included any devices for converting electrical energy into mechanical energy. Strictly speaking, however, it is but fair to give to the term mechanical energy a wide interpretation, such as would, for example, permit the introduction of any device for translating electrical energy into telephonic or telegraphic vibrations.

Under devices for the measurement of electrical energy would be included all electrical measuring and testing apparatus.

In this series of articles the principles underlying the construction and use of the apparatus described under the preceding heads will be considered, rather than the technique involved in their application.

2. A consideration of the foregoing classification will show that in all cases of the application of electro-dynamic machinery, mechanical energy is transformed by various devices into electrical energy, and utilized by various electro-receptive devices that are connected with the generators by means of conducting lines of various descriptions. The engineering problem involved in the practical application of electro-dynamic machinery can therefore be resolved into the simple case of economically generating a current and transferring it to the point of utilization with as little loss in transit as possible. The best economic conditions under which to solve any particular problem will necessarily depend largely upon the conditions of the case, but, generally speaking, all such problems resolve themselves into a variety of general cases, which will hereafter be discussed.

3. A dynamo electric generator is a machine in which conductors attached to a moving part, generally the *armature*, are caused to cut *magnetic flux paths* under conditions in which an expenditure of energy is required to maintain the motion. Under these conditions, electromotive forces are generated in the conductors.

Since the object of the electromotive force generated in the armature is the production of a current, it is evident that, in order to make the current strength as great as may be desired, either the electromotive force must be increased, or the resistance diminished, as far as practicable.

Electromotive sources must be regarded as producing, not electric currents, but electromotive forces, and, other things being equal, that type of dynamo will be the best which produces, under given conditions of resistance, speed, etc., the highest electromotive force. In designing a dynamo, therefore, the electromotive force of which is fixed by the character of the work it is required to perform, the problem resolves itself into obtaining a machine which will satisfactorily perform its work at a given efficiency, and without overheating.

4. There are various ways in which the electromotive force of a dynamo may be increased.

(1.) By increasing the speed of revolution.

(2.) By increasing the magnetic flux through the machine.

(3.) By increasing the number of turns on the armature.

The increase in the speed of revolution is limited by well-known mechanical considerations. Such increase in speed means that the same wire is brought through the same magnetic flux more rapidly. To double the electromotive force from this cause, we require to double the rate of rotation, which would, in ordinary cases, carry the speed far beyond the limits of safe commercial practice.

Since the E. M. F. produced in any wire is proportional to its rate of cutting magnetic flux, it is evident that to double the E. M. F. in a given wire or conductor, its rate of motion through the flux must be doubled. This can be done, either by doubling the rapidity of rotation of the armature, or by doubling the density of the flux through which it cuts, leaving the rate of motion the same.

Since the total E. M. F. in any circuit is the sum of the separate E. M. Fs. contained in that circuit, if the number of separate wires, each the seat of an E. M. F., be connected in series, the total E. M. F. will be the sum of their separate E. M. Fs. If, therefore, several loops of wire be moved through the magnetic field, and these loops be connected in series, it is evident that, with the same rotational speed and flux density, the E. M. F. generated will be proportional to the number of turns.

An increase in E. M. F. under any of these heads is limited by the conditions which arise in actual practice. As we have already seen, the speed is limited by mechanical considerations. An increase in the magnetic flux is limited by the permeability of the iron—that is, its capability of conducting magnetic flux—and the increase in the number of turns is limited by the space of the armature which can properly be devoted to the winding.

5. It will subsequently be shown that a definite relation exists between the output of a dynamo, either for continuous or alternating currents, and the relative amounts of iron and copper it contains—that is to say, the type of machine being determined upon, given dimensions and weight should produce, at a given speed, a certain output. The conditions under which these relations exist will form the subject of future consideration.

6. Generally speaking, there exists in the case of every machine a constant relation between its electromotive force and resistance, which may be expressed by the ratio, $\frac{E^2}{r}$ where E is the E. M. F. of the machine at its brushes, and r the resistance of the machine; *i.e.*, its internal resistance. In any given machine, the above ratio is nearly constant, no matter what the winding of the machine may be; *i.e.*, no matter what the size of the wire employed.* This ratio may be taken as representing the electrical activity of the machine, on short circuit, in watts, and may be conveniently designated the electrical capability of the machine. For example, in a 200-kw. (200,000 watts) machine—*i. e.*, a dynamo. whose output is 200 kw. (about 267 h. p.), the value of its electrical capability would be about 10,000 kw., so that, if its E. M. F. were 155 volts, its resistance would be 0.0024 ohm.

7. Hitherto we have considered the energy absorbed by the dynamo, independently of its external circuit—that is, we have considered only the electrical capability of the machine.

When the dynamo is connected with an external circuit, two extreme cases may arise.

(1.) When the resistance of the external circuit is very small, so that the machine is practically short circuited. Here all the electrical energy is liberated within the machine.

(2.) When the external resistance is so high that the resistance of the machine is negligible in comparison. Here practically all the energy in the circuit appears outside the machine. Between these two extreme cases an infinite number of intermediate cases may arise.

8. By the *output* of a dynamo is meant the electrical activity of the machine in watts, as measured at its terminals; or, in other words, the output is all the available electrical energy. Thus, if the dynamo yields a steady current of 500 amperes at a steady pressure or E. M. F., measured at its terminals, of 110 volts, its output will be $110 \times 500 = 55{,}000$ watts, or 55 kilowatts.

The *intake* of a dynamo is the mechanical activity it absorbs, measured in watts. Thus, if the dynamo last considered were driven by a belt which ran at a speed of 1,500 feet per minute, or 25 feet per second, and the tight side of the belt exerted a stress or pull of 2,500 pounds weight, with the tension on the slack side of 710 pounds weight, the effective force, or that exerted in driving the machine, would be 1,790 pounds weight. This force, moving through a distance of 25 feet per second, would do an amount of work represented by $1{,}790 \times 25 = 44{,}750$ foot-pounds per second; and one foot-pound per second is usually taken as 1.356 watts, so that the intake of the machine is 60,680 watts, or 60.68 kw.

By the *commercial efficiency* of a dynamo is meant the ratio of its output to its intake. In the case just considered, the commercial efficiency of the machine would be $\frac{55}{60.680} = 0.9064$.

*This ratio would be constant if the ratio of insulation thickness to diameter of wire remained constant through all sizes of wire.

By the *electrical efficiency* of a dynamo is meant the output, divided by the total electrical activity in the circuit. Thus, if the dynamo just considered had a total electrical energy in its circuit of 57 kw., of which 2 kw. was expended in the machine, its electrical efficiency would be $\frac{55}{57} = 0.965$.

9. The output of the machine would be greatest when the external resistance is equal to the resistance of the machine. In this case, the output would be just one-quarter the electrical capability, and the electrical efficiency would be 0.5. Thus, the resistance of the dynamo considered above would be 0.008 ohm, and the electrical capability of the machine $\frac{110^2}{0.008} = 1,512,500$ watts, or 1,512.5 kw.; and if the external resistance were equal to the internal resistance—namely, 0.008 ohm—the total activity in the circuit would be 756.25 kw.; the output would be 378.12 kw., and the electrical efficiency 0.5.

That is to say, in order to obtain a maximum output from a dynamo machine, the circumstances are such that half the electrical energy must be developed in the machine and half in the external circuit; or, in other words, the electrical efficiency can be only 0.5. In practice, however, it would be impossible to operate a machine of any size under these circumstances, since the amount of energy dissipated in the machine would be so great that the consequent heating effects would destroy the machine.

10. We have seen that whenever the resistance in the external circuit is indefinitely great, compared with that of the machine, the electrical efficiency of the machine will be 1.0, or 100 per cent. It is evident, therefore, that in order to increase the electrical efficiency of the dynamo, it is necessary that the resistance of the external circuit be made great, compared with the internal resistance of the machine. For example, if the external resistance be made nine times greater than that of the internal circuit, then the electrical efficiency will be $\frac{9}{9+1} = 0.9$; and, similarly, if the external resistance be nineteen times that of the internal resistance, the electrical efficiency would be raised to $\frac{9}{19+1} = 0.95$.

11. Care must be taken not to confound the electrical efficiency of a machine with its electrical output. The electrical output of a machine would reach a maximum when the electrical efficiency was 0.5, or 50 per cent., and the output would be zero when the electrical efficiency reached 1.0.

The electrical efficiency of large dynamos is very high, about 0.985. Indeed, the electrical efficiency of such machines must necessarily be made high, since otherwise the loss of energy within them would cause them to overheat.

The commercial efficiency of a dynamo is always less than its electrical efficiency, since all mechanical and magnetic frictions, such as air resistance, journal-bearing friction, hysteresis and eddy currents come into account among the losses. The commercial efficiency also depends upon the type of machine, whether it be belt-driven, or directly mounted on the engine shaft. It will also vary with the character of the iron employed in its field magnets and armature, and with the care exercised in securing its proper lamination. In large machines, of say 500 kw. capacity, the commercial efficiency may be as high as 0.95. In very small machines, of say 0.5 kw., the highest commercial efficiency may be only 0.65.

LABORATORY OF HOUSTON AND KENNELLY, PHILADELPHIA.

(To be continued.)

Resonance Analysis of Alternating and Polyphased Currents.*

BY M. I. PUPIN.

The method described in this paper of analyzing alternating current waves by electrical resonance is one suggested by Dr. Pupin in a paper which appeared in the American Journal of Science, of May, 1893. The aim of the experiments was to detect the presence of harmonics, to trace their origin, and to study their variations with the variation of the load, and of other elements of the circuit on which these harmonics seem to depend. For the details of the experiments, and of the resonance apparatus employed, the reader is referred to the original paper.

The presence of upper harmonics in an alternating current wave is a fact which deserves careful consideration, both on account of the purely scientific interest which is attached to it, and also on account of the technical bearing of electrical resonance upon the construction of conductors possessing appreciable distributed capacity.

That alternating current and electromotive force waves of a great variety of forms can be produced by properly designing the pole pieces of the field magnet and the iron core of the armature of an alternator is a fact nearly as old as the discovery of electromagnetic induction. Fully as old is also the knowedge that a great variety of alternating current and electromotive force waves can be obtained by means of the induction of an intermittent current.

The first set of experiments to locate the origin of higher harmonics was performed with a 10 h.p. Fort Wayne 8-pole alternator with a smooth core armature and a Stanley 5 kw. transformer. The general conclusion of this group of experiments is summed up as follows:

I. A ferric self-inductance in circuit with an alternator which gives a simple harmonic electromotive force distorts the current by introducing higher odd harmonics, principally the harmonic of three times the frequency of the fundamental.

II. This harmonic (and in all probability all other harmonics) increases at the same rate as the fundamental when the excitation increases, the rate of increase being up to 4,000 C. G. S. lines of force per sq. cm. proportional to the intensity of magnetic induction in the core of the ferric inductance.

III. When this ferric induction is a transformer, then the distortion appears, but not seriously, in the induced secondary electromotive force if the transformer has an open magnetic circuit; it does not appear there to any extent worth considering if the magnetic circuit is a closed one.

IV. A practically simple harmonic electromotive force is produced by alternators with smooth core armatures, even if the machine is worked at considerable degrees of magnetization of the armature core.

Another set of experiments was performed with the same object, using a one-h. p. 16-pole alternator with a Crocker-Wheeler slotted core armature wound for 500 volts, but run at a speed giving 1,500 volts.

The transformer connected with it was of induction coil type, with a cylindrical iron core made up of very carefully insulated thin iron wire. As a result of the experiments made with this apparatus the following conclusions can be added to the above:

V. An alternator with slotted core armature produces a complex harmonic electromotive force in which the upper harmonic of three times the frequency of the fundamental is generally by far the strongest.

VI. The amplitudes of the fundamental and the harmonic increase at the same rate with the increase of excitation; this rate is proportional to the excitation, that is to say, proportional to the magnetization of the armature.

VII. A ferric inductance in circuit with a slotted iron core armature introduces no new harmonics. It seems to strengthen those already existing in the electromotive force, that is odd harmonics, especially the first odd harmonic.

The same conclusions will evidently hold true for alternators of ordinary types, that is alternators whose armature is made up of coils wound on iron cores which are bolted to a cylindrical iron drum common to all of them.

It is a well-known fact that the distortion of the primary current disappears gradually with the increase of the secondary load, that is when the external part of the secondary circuit is a non-self-inductive resistance. The question arises now, what becomes of the harmonics which produce the distortion in the primary when the secondary current increases? To answer this question experiments were performed with the large alternator and 5 kw. transformer, the more important conclusion being that the harmonic which manifests itself in the distortion of the primary current when there is no load in the secondary is present at all loads, if not stronger, then certainly with about the same strength. At full load this harmonic could not possibly be detected by Joubert's method of sliding contact, being so exceedingly small in comparison to the fundamental. This persistence of harmonics at all loads, even when completely hidden by the fundamental wave, holds true also when their origin can be traced to the action of the armature of the generator, as in the case of the machine with slotted iron core armature. In all cases their strength seems to depend upon the mean intensity of magnetization of the magnetic circuits to which they owe their origin and upon nothing else.

Whatever the ultimate meaning of the appearance and the persistence of the odd harmonics in an alternating current wave may be, Dr. Pupin says he is not quite prepared to state with any high degree of confidence. One thing is certain and that is that they are present at all loads with almost undiminished strength.

* Abstract of a paper read before the Philadelphia meeting of the American Institute of Electrical Engineers.

Their presence is hidden by the fundamental wave at heavy loads, but when conditions favoring resonance with any one of them arise, they will certainly come out and do all the mischief they can to the insulation. The self-induction of a motor or that of a closed magnetic circuit transformer has practically no bearing upon the conditions of their resonance. These conditions depend in such circuits solely upon the self-induction of the alternator on the one hand and the self-induction and static capacity of the line on the other. According to the experiments just described, the resonant current is confined entirely to the alternator and the line, the di-electric forming a part of its circuit. These observations will be modified in the case of transformers with open magnetic circuits and their equivalents, that is, closed magnetic circuits possessing considerable magnetic leakage, especially when the conditions of the line favor resonance with the fundamental frequency, this frequency being low; such magnetic circuits possess much less magnetic sluggishness and can influence considerably the conditions of resonance with a low frequency.

It was pointed out that the superposition of harmonics upon the fundamental wave was confined to the primary circuit when the secondary is closed by a non-self-inductive resistance, that is, if the transformer is of closed magnetic circuit type. With an open magnetic circuit transformer the deviation of the primary current wave from the simple harmonic form, due to action of the generator or the transformer or both, is felt more or less in the secondary current also. If, however, the secondary is closed by a ferric self-inductance, then odd harmonics will appear in this circuit also in both types of transformers. In fact, the secondary circuit should now, as far as the harmonics are concerned, be considered as a separate circuit in which the secondary coil of the transformer and the ferric inductance in the secondary circuit play the same part as the armature of the alternator and the transformer play in the primary circuit.

The series of experiments which related to the origin and growth of harmonics in the secondary circuit was exactly the same as the one described above, by means of which the so-called distortion of the primary current was studied. The results were the same. The presence of harmonics is due to the action of the ferric inductance; their strength increases proportionally to the intensity of magnetization of the iron in the ferric inductance. They seem to be entirely independent of hysteresis, that is, if by hysteresis the process be understood by means of which most of the heat is generated in a very finely laminated, well insulated and well annealed iron core, when such a core is subjected to rapid reversals of magnetism. An experiment is then described which seemed to demonstrate that the theory which ascribes the origin of harmonics to the hysteretic action of iron is completely untenable.

While Dr. Pupin does not think that the proper time has arrived for the formulation of a physical theory which will give a complete account of the peculiar behavior of iron, by means of which it superposes odd harmonics upon the wave of a simple harmonic current, yet the view which irresistibly suggests itself to his mind is as follows: Upper harmonics will be generated whenever more or less abrupt changes of the magnetic state in any part of the magnetic field through which an alternating current flows occur. A slotted core armature or an armature made up of coils with iron cores distributed over a drum common to all of them will introduce such abrupt changes. An alternating current motor, especially when it is not of a smooth core armature type, will also cause abrupt changes of magnetism and hence cause strong deviations of the feeding current from the simple harmonic form. But if this view be correct, then every complete cycle of magnetization to which iron is subjected when under the inductive action of a simple harmonic current must be accompanied by some abrupt changes in magnetism, and that, too, whether the mean magnetic intensity of the cycle be large or small. A great many things may be suggested which could account for such cyclic abrupt changes. One thing is certain, and that is, that hysteresis, as commonly understood, will not account for them; for these peculiar abrupt cyclic changes, if they really exist and are the cause of harmonics, are not affected by mechanical vibrations by which, as is well known, all hysteretic effects are influenced very much. But whatever the real theory underlying these upper harmonics may be, the bare fact which the engineers have to face is: There is no cure against harmonics as long as the circuits contain iron. Hence construct your lines in such a way that conditions favoring resonance with the frequency of the fundamental or with one of its odd upper harmonics will seldom occur, and whenever they do occur the resonant rise of potential should not be capable of producing any damage. Avoid slotted armatures and armatures with projecting pole pieces and keep the magnetization down as much as possible.

The closing section of the paper is a description of the application of the resonance method of analysis to the study of the intensity fluctuations of a rotary magnetic field. The method, briefly stated, is this: A suitable number of turns of wire are subjected to the induction of a rotary magnetic field. These turns form part of a resonator. Whatever fluctuations there be in intensity of the rotary field they will be periodic, their period bearing a perfectly definite ratio to the periodicity of the current which produces the rotary field. For instance, in a three-phase combination of alternating currents, the intensity of the rotary field will, according to theory, show six maxima and six minima during each complete revolution, the maxima differing from the minima by about 14 per cent. A circuit subjected to the inductive action of such a field should have a periodic electromotive force induced in it whose frequency will be either three or six times the frequency of the fundamental, according to the shape of the curve of fluctuations. Similarly in a rotary magnetic field produced by a two-phase combination of alternating currents. If such electromotive forces were induced the resonator would detect them, and from the resonant rise of potential the extent of the fluctuations producing these electromotive forces could be estimated.

No electromotive forces of this type were detected in either a triphase or a two-phase combination. Hence the inference: Rotary magnetic fields produced by reasonably well constructed machines are not accompanied by fluctuations in their intensity.

The Meeting of the Canadian Electrical Association.

The next convention of this association will be held in Montreal the latter part of September, and will be one of unusual interest. The date of the convention will, if possible, be arranged to suit the usual fall railroad excursions to Montreal and Quebec. The meetings will be held in Mechanics' Institute, and will extend over three days. The following papers will be read:

"The Possibility of Securing Better Regulation at Central Light and Power Stations by means of Fly Wheel Accumulators of Improved Construction," by Mr. John Galt, Toronto; "A Method of Distribution with Equalization of Potential Difference," by Mr. D. H. Keeley, of the Government Telegraph Service, Ottawa; "The Application of Electricity for Medical and Kindred Purposes, from Light and Power Circuits," by Mr. W. B. Shaw, Montreal; "Electrolysis," by Mr. J. A. Baylis, Bell Telephone Company, Toronto; "Telephone Cables, their Construction and Maintenance," by Mr. F. J. F. Schwartz, Bell Telephone Company, Montreal; "Alternating Motors," by Mr. L. M. Pinolet, Montreal; and papers by Mr. E. C. Breithaupt, Berlin, Ont., Mr. T. R. Rosebrugh, Lecturer in Electricity, School of Practical Science, Toronto, and Mr. John Langton, Toronto.

The social part of the programme will be looked after by the Montreal Committee, and will include visits to McGill University, the power station of the Montreal street railway, and other electrical works; an excursion to Lachine and down the Rapids; drive to Mount Royal Park; trip over the Montreal Island Railway, and inspection of the docks and ocean steamers, etc., etc.

Seismic, Magnetic and Electric Phenomena.

The current issue of the Seismological Magazine contains an interesting article on "Seismic, Magnetic and Electric Phenomena," by John Milne, Professor of Mining and Geology in the Imperial University of Japan. Perhaps no one is so well qualified to speak upon this subject as Prof. Milne, and consequently his conclusions given below will be read with interest:

"Although in this and other papers I have brought together a considerable number of observations that would lead us to believe that there might be a connection between earthquake and magnetic and electric phenomena; that hypotheses have been formulated to assist in the conception of the possibility of such connection; that a variety of experiments and investigations have been made to test whether earthquakes were preceded, accompanied, or followed by magnetic or electric phenomena, the results obtained do not guarantee the existence of such connections.

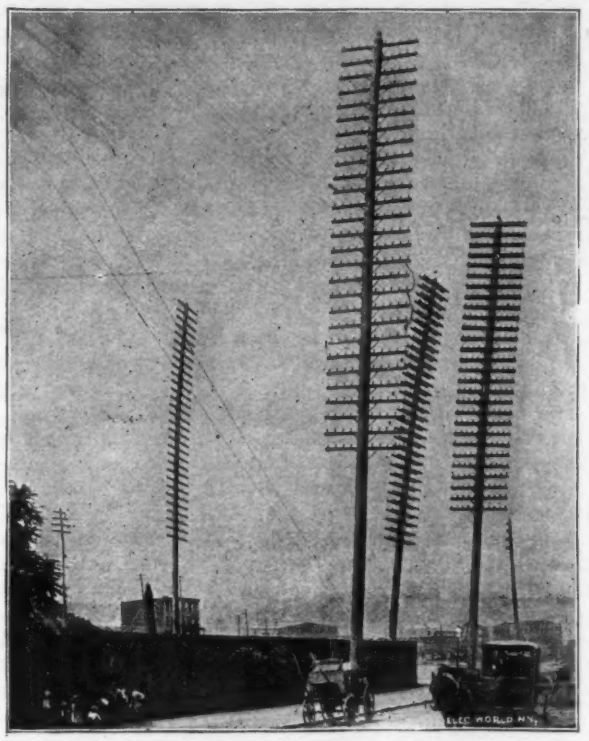
"It does not seem likely that earthquakes can result from electric discharges, and it has not yet been proved that they give rise to electric phenomena. When they have resulted in the displacement of large masses of rocky strata, as happened in 1891 in Central Japan, slight local changes in magnetic curves have resulted, but beyond this and effects due to the mechanical shaking of earth plates, our certain knowledge is exceedingly small."

How the Telephone Company Reaches a Subscriber.

BY W. L. HEDENBERG.

The telephone is in such general use at the present day, not only for business purposes, but for social intercourse as well, that it may be of interest to describe the usual method of reaching a subscriber from a central station, and to point out, at the same time, a few improvements that have recently been made in this city in house-top construction work.

Many of my readers have no doubt visited telephone exchanges, and there seen a number of girls busily engaged in answering calls and connecting different subscribers. The attention of an operator



THE LARGEST POLE LINE IN THE WORLD.

is called to the want of a patron by the falling of a little brass drop. This drop is worked by a small mechanical device, too intricate to discuss at length in this article; and we will simply pass over it with the statement that the subscriber, in ringing his bell, causes a current of electricity to pass through a small coil of wire with an interior core, which core, when electrified, attracts a small lever, and this lever, in moving, allows the above mentioned drop to fall. Consequently, when a person becomes impatient and rings the bell of his telephone long and hard, he does not startle the telephone office by the noise, as he might be led to suppose; the drop simply falls.

The wires are brought to the switchboard in an oval-shaped cable, the ends being fanned out and connected with the various drops. The other end of this cable terminates, in the new exchanges which are now being built in this city, in what is known as an intermediate distributing board. This consists of an iron frame, in which all of the wires are numbered. Another cable starts from the other side of this frame and terminates on one side of the main distributing board. The ends of the two cables just mentioned are connected across the intermediate distributing board by insulated wires. The cable then starts from the main distributing board, being connected with the cable on the opposite side, as in the intermediate board, and next passes through the lightning arresters. At this point the wires of the cable are connected directly with the subway cable, which terminates in a cable head.

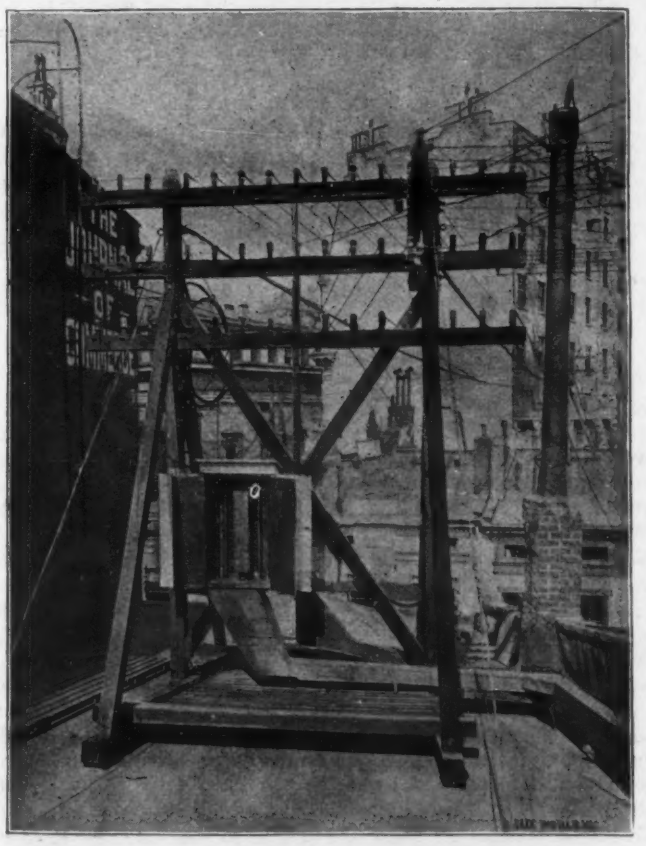
The intermediate distributing board is something comparatively recent, its principal advantage being the ease with which a number of subscribers may be transferred from one operator to another, in case the first operator receives more calls than she can readily answer.

The method of connection just described may seem to be comparatively simple; but the difficulties rapidly increase when there are some 15,000 wires to be looked after, as is the case in the Cortlandt street exchange of the Metropolitan Telephone and Telegraph Company.

Under the streets of New York city, as every one is aware, there is a network of subways. They have all been built in recent years, and others are in course of construction. The New York Board of Electrical Control is steadily forcing all overhead wires and pole lines under ground. By the end of this year no pole lines will exist in New York city, except the great east and west pole lines, the latter being, by the way, the largest pole line in the world, carrying twenty-eight cross arms. As soon as a new subway is completed in a street where a pole line exists, the overhead wires are ordered down, and are placed in the subway, in the form of a lead cable. These cables contain usually fifty-one pairs of wires, and are pulled through the three-inch subway iron pipe, called a duct.

The method of drawing a cable through a long stretch of subway between two manholes is quite ingenious. A man stands in the manhole with a bundle of short rods, about three feet in length, with brass ends so constructed that one will fit into another and stand a large amount of pushing or pulling without parting. A rod is inserted in a duct; another one is then clamped on and pushed forward, this process of joining being continued until the first rod appears at the next manhole. The last rod has a small rope fastened to it, the latter being in turn joined to a No. 6 wire, which is made fast to the end of the cable. A man in the second manhole disconnects the rods and draws the rope and wire through. The latter is made fast to a windlass, and by this means the lead cable, weighing about six pounds per foot, is slowly unreeled and drawn through the duct.

We will now go back a step and follow a cable after it leaves the cable head above mentioned. On emerging from the basement of



OLD STYLE LINE SUPPORT.

the central station, it enters a manhole, where it is spliced to another cable having the same number of wires, but running at right angles to it. After each wire has been connected with the corresponding one in the other cable, hot paraffine is poured over the loose wires; a lead sleeve is slipped over the joint, each end of the sleeve being sealed with hot lead, thus making a water and air tight connection with the lead covering of each cable. Great care must be exercised to prevent the wires of the cable from becoming moist or damp, due to poorly connected joints, for there would then be electrical leakage, or the resistance of the wires would be reduced, as water saturated with impurities is a good conductor of electricity.

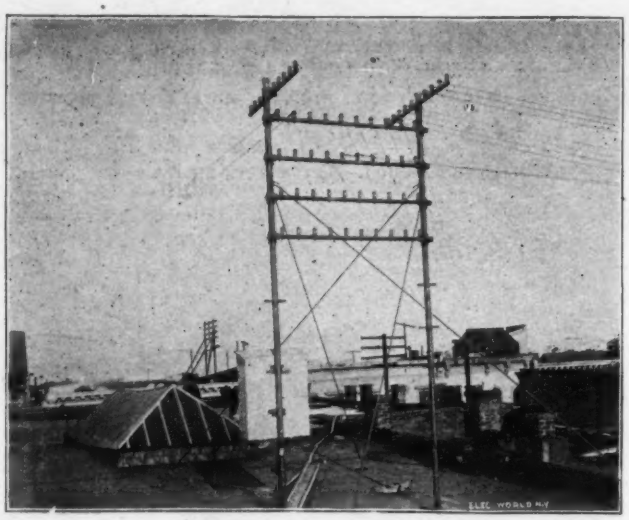
After passing through a mile or so of subway, the cable finally arrives in the district where the wires are to be distributed. A roof privilege is then obtained; or, in other words, the roof of some

high building, centrally located, is rented for a stipulated length of time. A fixture to hold the wires is then placed on the roof.

Until within a short time, the fixture used was of wood, as shown in the illustration. This, however, was found to be clumsy and unsightly, and an advance was made in the adoption of a light iron fixture (see illustration below), constructed of hollow iron pipe. This structure has many advantages over the old wooden one, as will appear later on.

Having reached the house selected, the cable is run up either the front or rear of it, in an iron pipe, to the roof, where it is boxed. It then enters the lower end of the cable box, as shown in the illustration of the wooden fixture. The end of the cable is fanned out, and the wires are fastened to brass binding posts; are then passed through lightning arresters, and finally come out of openings in the right and left-hand lower corners of the box. These wires are called bridle wires, and are heavily insulated. On the wooden fixtures, the bridle wires are taken up to the cross arms in a bunch, then fastened to the glass insulators, and conducted to any desired building in the neighborhood.

With the new iron fixture, the method of procedure is somewhat different. On leaving the cable box, the wires enter an oblong



New Style Line Support.

hole in one of the hollow iron uprights. Passing up the upright, a certain number of wires branch off and pass through each of the hollow cross arms. Near each insulator, and on the under side of the arm, there is a small opening, out of which the bridle wire is drawn, then fastened to the glass and run wherever required. It will thus be seen that the iron fixture has advantages over the older form in having the wires protected from the weather, and being decidedly more sightly in general appearance.

Iron fixtures for house tops have long been in use on the Continent; but until recently there has been a prejudice against their use in this country, owing to the fear that a telephone wire might become crossed with an electric light or other high-voltage wire, and thus be the means of electrifying the whole fixture. This is now remedied to a large extent, however, by the use of a heavily insulated telephone wire. The type of iron fixture which has just been described has been in use, in connection with the telephone plant of this city, for a number of months, and it has proven to be entirely satisfactory. There are now about 160 of them in working order, and additional ones are being erected nearly every day.

Subways are now being constructed throughout some of the principal streets in such a manner that subscribers may be served directly from the ducts, without any overhead wires whatever, so that in the near future even the roof fixtures may be a thing of the past.

A Definition of Darkness.

A German police regulation is said to require that every vehicle must have a lighted lantern from the beginning of darkness, darkness being defined as beginning when the street lamps are lighted. This reminds us of another police regulation in the same country which states that the lamps should not be lighted when the almanac says that the moon ought to shine; whether it is cloudy or not on such theoretically bright nights does not seem to make any difference.

Amateur Motor Building.

BY G. E. DUNTON.

In the following article a complete and clear description is given, with working plans and drawings, of a small electric motor, which any amateur of ordinary ability may be able to construct. The reader is not presumed to have any previous experience in electrical construction, or even any knowledge of electricity. Some of the simple laws, however, that are found in beginners' text books will be of benefit to the amateur, but all descriptions and methods used in these articles will be made so simple and concise that the beginner can, with their aid, understandingly construct an electric motor that will give as satisfactory results as the model described. The only condition presumed is that the amateur has some mechanical knowledge, though not necessarily being a technical machinist; also, that he possesses or has the use of a good engine lathe with jaw chuck that will hold work two and three-quarter inches in diameter, an assortment of drills, a vise and files.

The mechanical part of the construction will first be taken up. From a piece of good wrought iron steam pipe, two and one-half inches internal diameter, cut off a length of two and five-eighths inches. Wrought iron pipe of quarter inch stock will give better results, although the model illustrated is made from pipe of one-eighth inch stock. Put the piece into the lathe chuck, and at very slow speed bore out or turn the inside smooth from end to end, using a stiff diamond pointed tool. One very light cut will give the surface required. Square up both ends, round off the edges, and make the extreme length of the finished piece exactly two and one half inches.

The next step will be to drill the necessary holes in this, which will now be called the "magnet core;" seventeen in all will be necessary, but we will now drill nine only. With a small square butted across the end, draw a line with a scratch awl, down the outside from end to end. Turn the core over and at a point diametrically opposite draw a second line parallel to the first. Particular pains should be taken to have these lines come exact in relative position. Mark off points on each line half an inch from each end and "prick punch" the centres. Four quarter-inch holes may now be drilled on these centres and countersunk for flat head 14-20 machine screws. The pole pieces (see Fig. 1, A) are to be fastened to the core through these holes, so it will be at once apparent that it is important to have them come exactly opposite. We shall now need to draw two more lines, one on each side and exactly half way between the two already drawn. Prick punch on these lines for holes half an inch from each end of the core, and on one line only, a hole in the centre of its length. Drill the five holes, two on one line and three on the other or opposite line, which will be the top of our core. Use a No. 37 drill for these holes as they will be tapped for a 6-32 screw.

The easiest way to make the pole pieces is to make a pattern and have them cast; though unless a steel or wrought iron casting can be procured, they cannot be made nearly as efficient as those shaped from wrought iron. The pole pieces on the model are shaped out of Norway bar iron, and although it takes more time and patience, the writer believes that the builder will feel better satisfied in the end if he uses the wrought iron. From a piece of the best Norway bar iron, one inch by one and one quarter inches and eight inches long, cut into two pieces four inches long. A flat arbor half an inch thick, as wide as our bar (a little wider will do no harm) and about six or eight inches long will be needed. A boring bar will do. The two pieces of iron should now be placed on the opposite and wide flat sides of the arbor and strapped on solidly, putting a piece of tin between each piece and the arbor. Fasten the straps on well out at the ends (see Fig. 2) and do not remove both straps at one time until the pole pieces are fitted to the core finally. In turning up the ends, remove one strap at a time, setting it up into the middle while that end is being turned. Carefully turn down the pieces to a snug fit to the inside of the core. After this has been done nicely, and before the pieces have been taken off the arbor, square up both ends, turning as near down to the arbor as it is safe to run the lathe tool. The teats remaining may be taken off with a hack-saw. The finished length of the pole pieces should be just three and one-quarter inches. After taking them off the arbor, draw a line on each of the rounding sides which have been turning, up and down through the centre of the length and continue it across the ends. On the sides and on this line centre for a hole seven-eighths of an inch from each end; drill these four holes with an eleven sixty-fourths of an inch, or a No. 15, drill and tap out with a No. 14-20 tap. Centre on each end on the line for a hole one-fourth of an inch from the

rounding side, and drill in just five-eighths of an inch, using the same drill, and tap with a 14-20 bottoming tap (see Fig. 1, B).

Before boring out our pole pieces, by planing the sides and also channelling out a V-shaped groove up and down the sides, a better looking job will result, but is not absolutely necessary. The groove should be made one-quarter inch deep at the centre and bevelled flush up to the rounding side, or its edge, and to a line half an inch from the bottom edge. (See Fig. 1, C.) Much of the stock may be also planed from where the bore will be made, thus saving much time. The pole pieces should be firmly bolted into place in the core and numbered, to insure their being returned to the same side after they are taken out. Do not use the machine screws intended for permanent or final use, but find some hexagon cap screws for temporary use. Place the core in the lathe chuck, centre very accurately, and at the slowest speed proceed to bore out between the poles, using a pretty stiff inside diamond tool. The finished bore should caliper one and three-eighths inches, exact diameter. The studs that support the yokes and bearings for the armature shaft are made from a piece of five-eighths of an inch, round, refined iron, one foot long, which is cut into four pieces, making two of them three and three-eighths inches long, and the others two and three-eighths inches long. Each piece is centred and turned up, as shown in Fig. 3, and nicely polished; threads are then cut on the ends of each with a 14-20 die or screw plate.

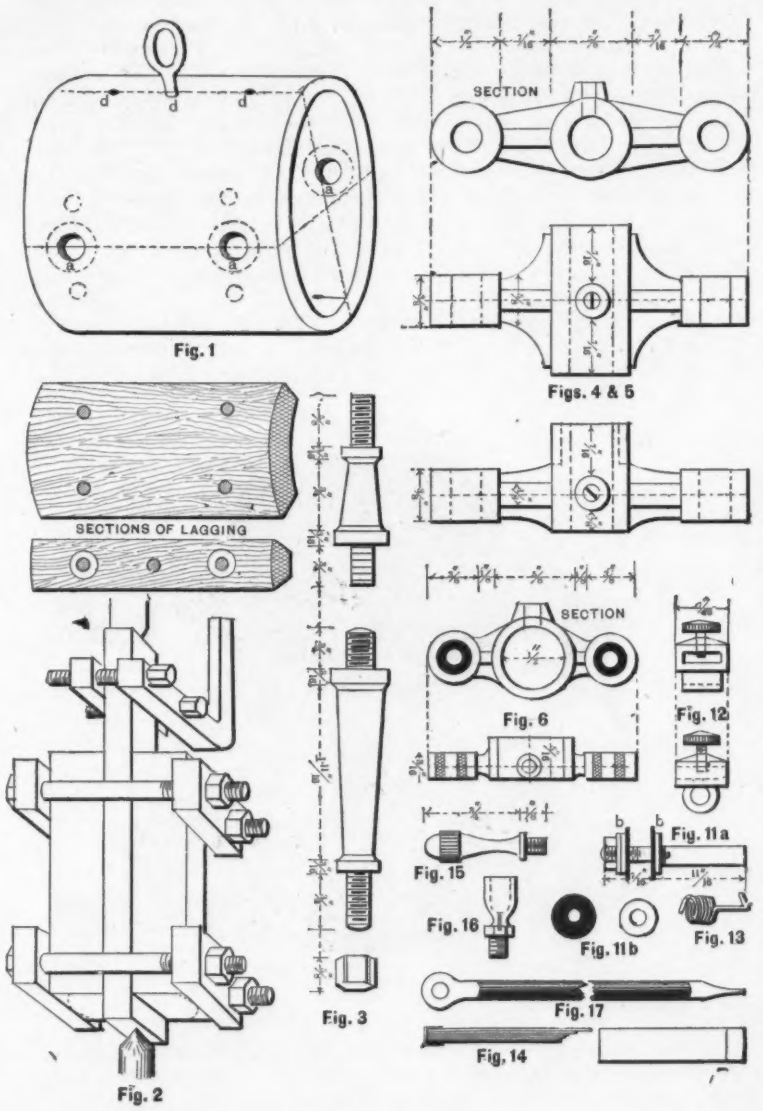


Fig. 1 Figs. 4 & 5 Fig. 2 Fig. 3 Fig. 6 Fig. 12 Fig. 11a Fig. 15 Fig. 16 Fig. 11b Fig. 13 Fig. 17 Fig. 14

DETAILS OF MOTOR.

The best way to make the bearing yokes or hangers, and the only way to insure a neat and finished result, is to make the patterns and have them cast, either of brass or phosphor bronze; if of brass, a phosphor bronze or steel bushing should be put in for the shaft to run in as the motor will have a speed of 3,500 revolutions per each minute, and should have an extra good wearing journal. The entire yoke could not be made from either steel or iron, as it must be some non-magnetic material, but the bushing can be steel. Fig. 4 fully illustrates the front hanger or yoke, and Fig. 5 the back yoke. It will be noticed that the bearing boss or journal is most all on one side of the yoke in Fig. 4; the outside of this will be turned down to allow the brush yoke to swing around on it. The journal on the back or pulley end is longer and more evenly divided on each side of the yoke. (See Fig. 5.) The bosses on the ends should be centred and drilled with quarter inch holes, to allow the ends of the studs, shown in Fig. 3, to pass through easily. To insure greater accuracy in locating these stud holes, with the studs in their respective places in the pole pieces, take the exact measure from centre to centre of the stud ends. Set your dividers to exactly half this measure. Centre the bearing boss, and then with the dividers the centres of the holes for the stud ends can be located very nicely.

The castings should be all finished up smooth, and held in place with some little nuts made from three-eighths inch hexagon iron

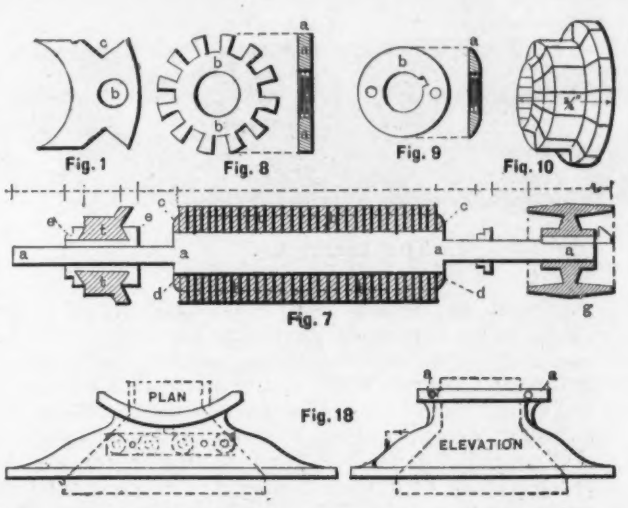


Fig. 1 Fig. 8 Fig. 9 Fig. 10 Fig. 7 Fig. 18

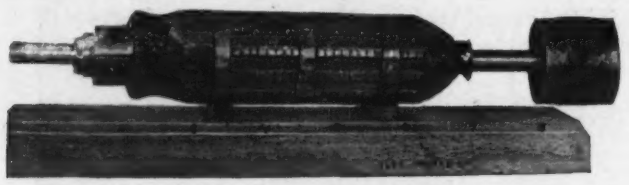
bar, tapped to the thread on the studs. The little brush yoke casting should also be of brass.

All patterns for small castings the writer makes of lead, such as electrotypers use in their casting, turning out all the bosses and soldering together with bismuth solder; this makes an elegant pattern. The armature will run very snug between the magnet poles, having only three sixty-fourths of an inch total clearance. This will necessitate the bearings being bored perfectly true with the centre of the polar bore, which may be done by drilling a five sixteenths of an inch hole through the centre of the diameter of a cast-iron plug two inches long and one and one-half inches in diameter from end to end. Put the plug on an arbor and turn down to one and three-eighths inches, so it will just fit the polar bore snugly; place this in the bore and drill one hanger at a time through it, mark it and take off. Put the other hanger on its respective end and do the same. Of course the drill is to go through the cast-iron guide first, drilling through the bearing from the inside. In this way the hole cannot fail to centre with the bore of the poles. If the beginner tries to locate these hole centres by measurements, he will find he has quite a difficult task to perform, and very likely not strike it exact after all. The hangers should be put in the lathe on an arbor, and all the bosses faced up nice and true. The outside of the bearing boss on the commutator, or front end hanger, should be turned down to seven-sixteenths of an inch, to allow the brush yoke to slip on over the outside of it. The dotted lines in Fig. 4 illustrate this.

For the armature shaft use a piece of half inch round tool steel eight and one-half inches long. Centre very accurately and turn down to seven-sixteenths of an inch. On the commutator end, for a distance of two and one-half inches from the end of the shaft, turn down to five-sixteenths of an inch. On the pulley end do the same, for a distance of two and five-eighths of an inch from the end of the shaft. (See Fig. 7, A.) In building up the armature core, a washer one and three-eighths inches in diameter, about seven sixty-fourths of an inch thick, and which has a seven-sixteenths of an inch hole, can be purchased at the hardware stores. (Fig. 8, A.) This kind of a washer was used in the model and gives perfect satisfaction, although the writer would recommend the builder to use the thinnest charcoal or Russia stove iron if he is able to shape the washers readily. On each end of the hub, or larger part of the shaft, which should be just three and three-eighths inches long, cut a fine machine thread one-eighth of an inch long, forty to the inch if the lathe will cut this fine. Two

washers, one-eighth of an inch thick, and one inch in diameter, tapped to screw on to this thread on these hub ends will be needed; one edge should be nicely rounded off on one side only. (See Fig. 7, C.)

The armature core may now be built up. Mix up some shellac and lampblack, quite thick; get some thin tissue toilet paper, cut into pieces about one and one half inches square, and punch or cut a seven-sixteenths of an inch hole through the middle. Take the end washers, that have been tapped out, and file a key-way through the thread, one thirty-second of an inch deep and one-sixteenth of an inch wide, also through the thread on the shaft to correspond; drill two one-eighth inch holes in each of the end washers, half way between the edge of the central hole and the outer edge, on a diametrical line through the centre. (See Fig. 9.) This is for the use of a spanner in screwing the washers on. Screw one of the washers on to the shaft tight, bringing the key-ways in line, the rounded side facing the end of the shaft, and drive in a key of



The Armature.

soft iron, filing each end smooth (Fig. 7, D). Slip on over the shaft four sheets of the paper, and paint with the shellac mixture. Then dip one of the larger washers into the shellac and slip it down over the shaft on to the paper. The washer should slide down over the shaft readily and still fit tight. Put on two thicknesses of the paper, dip another washer, bringing it down on to the paper as before, and so on until the core is built up; putting only two thicknesses of paper between each washer, until the last one is reached, and then put in four as at first. This core will require about thirty-two washers besides the two end or set ones. The washers will set down some and should be squeezed up as hard as possible before the end washer is screwed home and keyed. The core should be thoroughly dried out in some gentle heat, but do not heat too much; steam heat is the best. After it is all dry, put it in the lathe and turn down very slowly and carefully to caliper exactly one and twenty-one sixty-fourths of an inch. In the middle of its length, and three-eighths of an inch from each end around the periphery of the core, turn grooves three sixty-fourths of an inch deep, and three-eighths of an inch wide. These are for the armature binders. (See Fig. 7 and also the picture of the finished armature.) The lathe should be fitted with centres that can be attached to the tool carriage in place of the tool rest, one centre being provided with an index and stop. Place the armature between the centres, and with a milling cutter or metal slitting saw, one-eighth of an inch wide on the cutting edge, running in the lathe, mill out twelve grooves or channels up and down the length of the core on its periphery, three-sixteenths of an inch deep and wide as shown in the washer in Fig. 8, B.

The commutator is one of the most particular and trying parts of the entire motor to make and get perfect. Most writers describe a commutator that in practice is worthless. The one herein described is one of the best, if the builder will only have the perseverance to construct it properly. The shell or sleeve is turned from a piece of seven-eighths inch round brass bar; cut off a piece one and one-eigths inches long, and drill a five-sixteenths of an inch hole through the centre of its length. Put this on the arbor and turn down to a diameter of half an inch, leaving a shoulder or hub on one end thirteen-sixteenths of an inch in diameter by one quarter wide or deep. (See Fig. 7, E.) This hub should be turned beveling from its outer edge in to the sleeve, one-eighth of an inch on the sleeve. On the other end of the sleeve a No. 24 thread should be cut one quarter of an inch from the end. A brass collar must now be turned out, thirteen-sixteenths of an inch in diameter, one quarter of an inch wide, concaved or bevelled on the inner side the same as the hub of the sleeve, and tapped out with a No. 24 thread to screw on to the end of the sleeve. A neat little hexagon nut may be shaped on the outer end, being careful not to file in more than one-sixteenth of an inch; or two one-sixteenth inch holes may be drilled on this end for a spanner to use in setting it up. (See Fig. 7, E.) In making the bars or segments of the commutator, it will be found much easier to proceed as follows. From a one and three-eighths inch round bar, cut off a piece to finish up three-quarters of an inch in length, and drill a hole five-eighths of an inch through the centre of the length. Put on an arbor and turn down to one and one quarter inches in diameter. Square up the ends to make the finished length three-quarters of an inch. On each end shape a bevelled lip or flange, projecting from the end, with its bottom resting on the arbor. (See Figs. 7, F, and 10.) This beveled flange should be one-eighth of an inch deep, and three thirty-seconds of an inch long on the under side (on the arbor). Again turn the face of the piece down to a diameter of one inch, leaving a hub projecting radially on one edge three-sixteenths of an inch wide; turn a slight groove around the middle of this hub one thirty-second of an inch deep by one-sixteenth wide. When the ring is sawed into segments, this hub will form the lugs into which to solder the wires coming from the armature. Divide the ring into twelve equal parts around its circumference, and with a hack-saw saw down through the divisions nearly to the central hole, but not quite separating the bars. With the very finest saw that can be obtained (a bracket saw will do very nicely), saw a slot down through the middle of each lug (one thirty-second of an inch deep), into which the ends of the commutator wires are to be soldered. The bars may now be separated, and the rough surfaces, where they were sawed apart, smoothed off with a file. In putting the commutator together, cut out two rings of fibre one thirty-second of an inch thick and seven-eighths of an inch in diameter, and cut a half-inch hole in the centre. Then soak them in warm water for about twenty minutes, when the fibre will become perfectly pliable. Cut some pieces of mica the shape of the bar to go in the spaces between the bars that have been sawed out. A thickness of one good heavy piece of mica or one sixty-fourth of an inch between each bar will do. Put one of the fibre washers on over the brass sleeve, pressing it well down into the groove. Cut a strip of thin asbestos paper exactly as wide as the

The Completed Motor.

commutator bar is long on its bottom, and wrap twice around the brass sleeve, butting snug up against the fibre collar. The bars, with a thickness of mica between each, may now be put in place around the paper and two or three turns of fine wire wound around the outside of the bars to keep them from falling apart. Put on the other fibre washer, screw on the end washer (the brass collar) and set it down firmly (See Fig. 7, F). Test each bar with its neighbor and also each bar with the brass to see that there is no short circuit anywhere. If proper care has been used it will be perfect. Should there be a short circuit found, however, it must be located and the cause removed. The little commutator when all completed should be just one inch long. The material of which the bars are made should be phosphor bronze or tempered copper; either common bar copper or brass is not fit. The segments of the commutator in the model are made from a piece of cast steel. This has been in use almost daily for over a year and is as smooth at this writing as the day put on; it has not been turned down or smoothed off once during that time. The commutator may be keyed on to the shaft or have a one-sixteenth inch set screw go through the end collar and the sleeve into the shaft. Set the commutator with its front end seven-eighths of an inch from the end of the shaft. (See Fig. 7.)

The construction of the brush holders and studs will give the amateur an opportunity to display his ingenuity. Drill a hole

through the centre of the boss on each end of the brush holder yoke three-sixteenths of an inch, and plug with hard rubber or fibre; finish off smooth with the face of the boss, then centre and drill a one-eighth of an inch hole through the centre of each plug. (See Fig. 6.) Make four fibre washers five-sixteenths of an inch in diameter, and one thirty-second of an inch thick, and drill an eighth of an inch hole through the centre of each. Four brass or copper washers, one-quarter of an inch in diameter, one thirty-second thick, with a one-eighth hole drilled through the centre of each. Small copper rivet burrs make these very nicely. (Fig. 11, B.) Make the brush holder studs of two pieces of three-sixteenths of an inch round brass rod, one and one-eighth of an inch long; turn down to a diameter of one-eighth of an inch, in a distance of three-eighths of an inch from one end. Cut a 6-32 thread on this extreme end, extending one-eighth of an inch from the end and provide two three-sixteenths hexagon brass nuts, tapped to that thread. (Fig. 11 A.) Put one of the metal washers on the stud, then a fibre washer. Put the stud through the already insulated hole in the end of the brush yoke, then put on another fibre washer, then a metal one, and screw the nut on. The end of the brush cable goes on, and the tension springs of the brush holders are to be adjusted before the nut is set up finally.

The brush holders are made from half-inch sheet or bar brass, as shown in Fig. 12, drilled with a three-sixteenth hole to go on over the studs, mortised out five-sixteenths of an inch by three thirty-seconds of an inch, with a small thumb screw through the top to hold the brushes in place. The uniform tension is given the brush by an eight turn coil of No. 24 brass spring wire, slipped on over the stud between it and the yoke. One end passes through a small hole drilled through the stud for it, and the other is bent around the under side of the brush holder. The brushes are made of very thin stencil copper, eight-ply, one and one-half inches long, one-sixteenth of an inch thick and nine thirty-seconds of an inch wide. (See Fig. 14.) The wearing end should be cut to the shape of the commutator, and the butt end have a short lap bent round its end and soldered.

The brush yoke must have a set or check screw; shape this out of a piece of three-sixteenths of an inch brass rod seven-eighths of an inch long. Cut a 6-32 thread on the end, extending one-eighth of an inch from the end to screw through the little boss on the top of the brush yoke, which should be tapped out for it. (See Fig. 15.) The oil cups are turned from five-sixteenths of an inch round brass rod, are three-quarters of an inch long, and have a 6-32 thread to screw into the little bosses on the upper side of the bearings, which should be drilled and tapped out for them. (Fig. 16.) The cables connecting the brushes with the fields are made from ordinary flexible lamp cord, each a single strand four inches long, the ends cleaned of their covering and fitted into pieces of small fish rod ferrule one-half inch long; the ends are flattened, then soldered, and a one-eighth inch hole drilled in each. (Fig. 17.)

The best way to make a pulley is to turn it out of a piece of round cast iron, one and one-half inches in diameter, and one and one-quarter long. Drill a five-sixteenth hole through the centre of its length and put it on an arbor. It is a very easy matter to turn it to the shape shown in section in Fig. 7, G. Cut a key-way in the pulley and shaft one-sixteenth of an inch wide, and one thirty-second deep in each, and key on with a nicely made iron key.

The construction of the base will depend on the use the motor is to be put to. If wholly for a fan motor, a taller base will be necessary. A light standard with spreading feet at the base would be very good. If to supply motive power, through a belt or gear, a base like that on the model will be the best. (See cut of the complete motor.) The pattern is made from a piece of two inch pine plank, five and three-quarters of an inch long and four and one-half inches wide at the bottom. The pattern must be in halves, split up and down throughout the centre of its length from bottom to top and have core prints at the top and bottom, as the base must be hollow. The dotted line in Fig. 18 shows this. Four three-eighths of an inch holes are drilled through the front side of the casting and bushed with hard rubber tube. A piece of fibre two and one-half inches long, one-half inch wide, and one quarter inch thick, mortised into and screwed to the casting over the insulated holes, holds the binding posts and field armature connections. Drill two holes at points on each side, and tapped out for a 6-32 threaded machine screw. Make out of black walnut two sections of lagging two and one-half inches long, two inches wide and one quarter of an inch thick, shaped to fit the periphery of the core nicely, and to be fastened in place with four machine screws, as shown in the picture of the finished motor. The two lower screws should be a little longer, as one end of the brass straps, holding the motor to its base, is fastened under these. Cut two more pieces of this lagging the same length and thickness as the first two pieces, but half an inch wide. Drill the holes to correspond with the screw holes in the magnet core. The edges should be beveled off radially with the diametrical centre of the core. Make the bottom side only three-sixteenths of an inch wide, and the upper one a full half inch. (See Fig. 1, D.) This practically completes the machine work on our motor, as it cannot be fitted to the base until the field is wound, and a brass collar, which goes on the pulley end of the armature shaft had better be left until the armature has been wound. The next section will take up the electrical details.

(To be continued.)

Practical Notes on Dynamo Calculation.—X.

BY ALFRED E. WIENER.

21. Running Value of Armature.

In order to form an idea of the efficiency of an armature as an inductor, its "*running value*" has to be determined.

In forming the quotient of the total energy induced by the product of the weight of copper on the armature and the field density, the number of watts generated per pound of copper at unit field density is obtained, an expression which indicates the relative inducing power of the armature:

$$\rho = \frac{E \times C}{lb_a \times \frac{\mathfrak{IC}}{20{,}000}} = 20{,}000 \times \frac{E \times C}{lb_a \times \mathfrak{IC}}; \qquad (54)$$

ρ = Running value of armature in watts per pound of copper, at unit field-density (20,000 lines of force per square inch);
E = Total E. M. F., generated in armature, in volts;
C = Total current, " " " " amperes;
lb_a = Weight of copper in armature, in lbs.; formula (28);
$\mathfrak{IC}$ = Field density, in lines of force per square inch;

The value of ρ for a newly designed armature being found, its relative inductor efficiency can then be judged at by comparison with other machines. The running value of modern dynamos, according to the kind of armature, varies between very wide limits, and the following are the averages:

TABLE XXXIII.—RUNNING VALUES OF VARIOUS KINDS OF ARMATURES.

Kind of Machine.		Kind of Armature.	Running Value. (Watts per lb. of copper, at 20,000 lines per sq. inch.)
High speed.	Bipolar	Drum	300 to 600
		Ring	200 " 400
	Multipolar	Drum	200 " 400
		Ring	150 " 300
Slow speed.	Bipolar	Drum	150 " 300
		Ring	100 " 200
	Multipolar	Drum	100 " 200
		Ring	75 " 150

22. Armature Torque.

The work done by the armature of a dynamo can be expressed in two ways: electrically, as the product of E. M. F. and current strength,

$$W = E \times C \text{ watts};$$

and mechanically, as the product of circumferential speed and turning moment, or torque,

$$W = 2\pi \times N \times T \times \frac{746}{33{,}000} = .142 \times N \times T \text{ watts};$$

W = Total energy developed by machine, in watts;
E = Total E. M. F. generated in armature, in volts;
C = Total current " " " " amperes;
N = Speed, in revolutions per minute;
T = Torque, in foot-pounds.

Equating the above two expressions, we obtain:

$$E \times C = .142 \times N \times T,$$

from which follows:

$$T = \frac{E \times C}{.142 \times N} = 7.042 \times \frac{E \times C}{N} \text{ foot-pounds} \qquad (55)$$

But the E. M. F. generated in an armature can be expressed, compare formula (51), by:

$$E = \frac{K \times \Phi \times N}{P \times 10^8 \times 60},$$

hence:

$$T = 7.042 \times \frac{K \times \Phi \times N}{P \times 10^8 \times 60} \times \frac{C}{N} = \frac{11.74}{10^{10}} \times \frac{C}{P} \times K \times \Phi \text{ foot-pounds} \qquad (56)$$

From this follows that in a given machine the torque depends in nowise upon the speed, but only upon the current flowing through the armature, and upon the magnetic flux.

23. Peripheral Force of Armature Conductors.

By means of the armature torque we can now calculate the drag of the armature conductors in a generator, respectively the pull exerted by the armature conductors in a motor.

The torque divided by the mean radius of the armature winding, in feet, gives the total peripheral force acting on the armature; and the latter, divided by the number of effective conductors, gives the peripheral force acting on each armature conductor:

$$f_p = \frac{T}{\frac{\frac{1}{2}d'_a}{12} \times K \times \beta'} = \frac{24 \times T}{d'_a \times K \times \beta'} \text{ pounds.}$$

Inserting in this equation the value of T from formula (55), we obtain:

$$f_p = \frac{24 \times 7.042 \times \frac{E \times C}{N}}{d'_a \times K \times \beta'}$$

$$= \frac{2 \times 7.042 \times \pi}{60} \cdot \frac{E \times C}{\left(\frac{N}{60} \times \frac{d'_a \times \pi}{12}\right) \times K \times \beta'}$$

or,

$$f_p = .7375 \times \frac{E \times C}{S \times K \times \beta'} \text{ pounds} \qquad (57)$$

f_p = Peripheral force, per armature conductor, in pounds;
$E \times C$ = Total output of armature, in watts;
S = Mean conductor velocity, in feet per minute;
K = Total number of armature conductors;
β' = Percentage of effective armature conductors, see Table XXXII.

A second expression of the peripheral force can be obtained by substituting in the original equation for f'_p the value of T, from formula (56), thus:

$$f_p = \frac{24 \times 11.74}{10^{10}} \times \frac{C}{P} \times \frac{K}{K \times \beta'} \times \frac{\Phi}{d'_a} = \frac{2.82}{10^8} \times \frac{C \times \Phi}{P \times d'_a \times \beta'} \text{ lbs.} \qquad (58)$$

Replacing in this the total useful flux, Φ, by its equivalent, the product of gap area and field density, we find a third formula:

$$f_p \times \frac{2.82}{10^8} \times \frac{C \times d'_a \times \frac{\pi}{2} \times \beta' \times l_a \times \mathfrak{C}}{P \times d'_a \times \beta'} = \frac{4.43}{10^8} \times \frac{C}{P} \times l_a \times \mathfrak{C} \qquad (59)$$

f_p = Peripheral force, per armature conductor, in pounds;
$\frac{C}{2P}$ = Total current flowing through each armature conductor, in amperes;
l_a = Length of armature core, in inches;
$\mathfrak{C}$ = Field density, in lines of force per square inch.

It is on account of this peripheral force exerted by the magnetic field upon the armature conductors that there is need of a good positive method of conveying the driving power from the shaft to the conductors, or vice versa; in the generator it is the conductors, and not the core-discs that have to be driven; in the motor it is they that drive the shaft. Thus the construction of the armature is aggravated by the condition that, while the copper conductors must be mechanically connected to the shaft in the most positive way, yet they must be electrically insulated from all metallic parts of the core. In drum armatures the centrifugal force still more complicates matters in tending to lift the conductors from the core; it has therefore been found necessary to employ driving horns, which either are inserted into nicks in the periphery of the discs, or are supported from hubs keyed to the armature shaft at each end of the core. In ring armatures the centrifugal force presses the conductors at the inner circumference towards the armature core, and thus helps to drive, while the spider arms, by interlocking into the armature winding, serve as driving horns. If toothed discs are used, no better means of driving can be desired.

24. Armature Thrust.

If the field frame of a dynamo is not symmetrical, which is particularly the case in most of the bipolar types (see Figs. 22 to 31), unless special precautions are taken there will be a denser magnetic field at one side of the armature than at the other, and an attractive force will be exerted upon the armature, resulting in an armature thrust toward the side of the denser field.

The force with which the armature would be attracted, if only one half of the field were acting, in absolute (C. G. S.) units, is:

$$f'_1 = 2\pi \times \frac{G'}{2} \times \left(\frac{\mathfrak{C}'_1}{4\pi}\right)^2 = G' \times \frac{\mathfrak{C}'^2_1}{16\pi} \text{ dynes;}$$

G' = Gap area, in square centimeters;
$\mathfrak{C}'_1$ = Field density, in lines of force per cm^2.
Or, in English measure, 1 square inch being equal to 6.45 cm.^{2}, and 1 pound equal to 444,980 dynes.

$$f_1 = \frac{6.45 \times G \times \left(\frac{\mathfrak{C}'_1}{6.45}\right)^2}{16\pi \times 444980} = 7 \times 10^{-9} \times G \times \mathfrak{C}^2_1 \text{ pounds} \qquad (60)$$

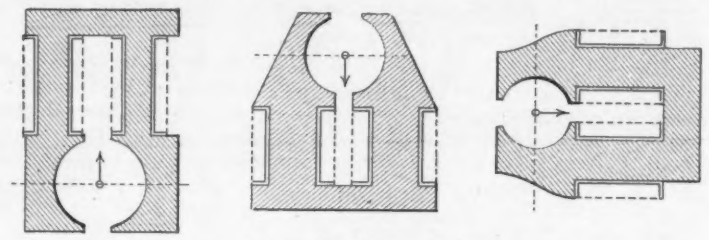
G = Gap area, in square inches;
$\mathfrak{C}_1$ = Field density, in lines of force, per square inch;

Expressing the gap area, G, by the dimensions of the armature, we obtain:

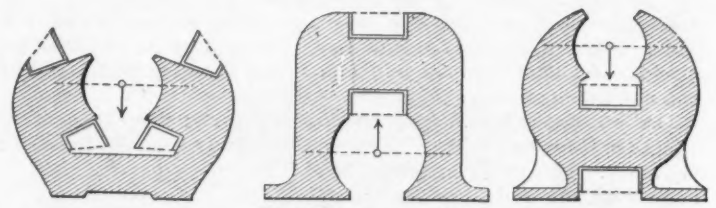
$$f_1 = 7 \times 10^{-9} \times \frac{d_a \times \pi}{2} \times l_a \times \beta' \times \mathfrak{C}^2_1$$

$$= 11 \times 10^{-9} \times d_a \times l_a \times \beta' \times \mathfrak{C}^2_1 \text{ pounds} \qquad (61)$$

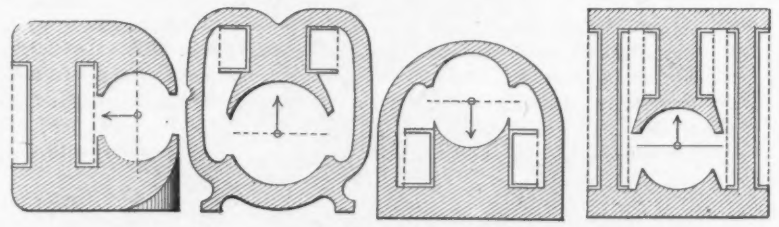
If, now, both halves of the field are in action, but one half is



FIGS. 22, 23 AND 24.



FIGS. 25, 26 AND 27.



FIGS 28, 29, 30 AND 31.

stronger than the other, the armature will be drawn towards the stronger side by the amount of the difference of their attractive forces. The armature thrust, therefore, is:

$$f_a = f_1 - f_2 = 11 \times 10^{-9} \times d_a \times l_a \times \beta' \times (\mathfrak{C}^2_1 - \mathfrak{C}^2_2) \text{ pounds} \qquad (62)$$

f_a = Attracting force acting on armature, due to unsymmetrical field, or armature thrust, in pounds;
d_a = Diameter of armature core, in inches;
l_a = Length " " " " "
β' = Percentage of effective gap circumference, see Table XXXII.;
$\mathfrak{C}_1$ = Density of field, on stronger side, in lines of force per square inch;
$\mathfrak{C}_2$ = Density of field, on weaker side, in lines of force per square inch.

In such types, where the attracting force of the field manifests itself as a downward thrust, as in those shown in Figs. 23, 25, 27 and 30, the value obtained by (62) is to be added to the dead weight of the armature, in order to obtain the total down thrust upon the bearings. If, however, f_a is an upward thrust, as is indicated in Figs. 22, 26, 29 and 31, the down thrust upon the bearings is the weight of the armature, diminished by the amount of f_a. In the cases illustrated by Figs. 24 and 28, the action of the field causes a sideward thrust, which has to be taken care of by a proper design of the bearing pedestals, or of the journal brackets.

(To be continued.)

THE ELECTRICAL WORLD'S DIGEST

OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS BY CARL HERING.

ELEC. WORLD, N.Y.

ELECTRO-PHYSICS.

Phosphoresence.—A chemical society paper by Mr. Jackson is mentioned in the London "Elec. Eng.," June 29. In many cases it cannot be ascribed to impurities; he attempts to show that fluorescence, phosphorescence in air on exposure to light, and phosphorescence of substances in a vacuum under the influence of electric discharge, are of the same nature, namely, a response on the part of the substances to the operation of radiant energy propagated like light in undulations of short length; some substances require very short undulations to which air is opaque, and they therefore phosphoresce in high vacua; the results of a very large number of experiments seem to indicate a close connection between phosphorescence of air and in vacua.

Transforming Mechanical into Electrical Energy.—An Academy paper by Mr. Vaschy is abstracted in "L'Ind. Elec." June 25, and somewhat more fully in "L'Elec.," and "La Lum Elec.," June 30. In the displacing of a conductor in an electric field, he establishes the fact that the work done by the dielectric on the conductor is the transference of the electric energy in the form of elastic energy or otherwise, localized in the volume abandoned by the dielectric; he discusses also the displacement of a dielectric body and of a magnet in a magnetic field.

Hertzian Waves.—A paper by Mr. Zehnder from the "Wied. Ann.," vol. 52, p. 34, is abstracted in the "Elek. Zeit.," June 14. He describes modified apparatus which enable the Hertzian researches to be demonstrated with much greater ease than heretofore. In place of the mirror of sheet metal he uses one made of woven wire, which may be made about one-third as large; the asphalt prisms are therefore also reduced in size; for a current interrupter he finds that the Deprez form answers best.

Magnetization by Hertzian Currents.—The researches of Dr. Birkeland are given briefly in the "Elek. Zeit.," June 14.

Magnetic Deflection of Cathode Rays.—Mr. Leonard's paper, mentioned in the Digest June 16 and 30, is abstracted in the "Elek. Zeit.," June 14, and "L'Ind. Elec.," June 10. A French translation of the article, together with the illustrations, is published in "L'Elec.," June 16.

Conductivity of Gases.—A note on a recently published article is given in the London "Elec. Rev." June 29.

MAGNETISM.

Variation of Hysteresis with Temperature.—A French translation of the complete article by Mr. Kunz, mentioned in the Digest May 12, together with the illustrations and tables, is published in "La Lum. Elec.," June 9.

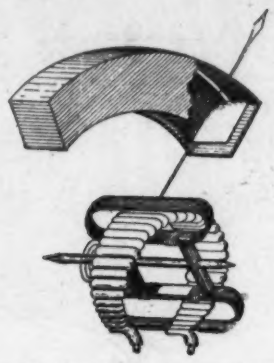
UNITS, MEASUREMENTS AND INSTRUMENTS.

Nomenclature.—In an article in "L'Ind. Elec.," June 25, written undoubtedly by Mr. Hospitalier, he approves very highly of the recent decisions of the American Institute of Electrical Engineers in adopting the names for the magnetic units, and remarks that in a few years these names will be as familiar to the electrician as ohm, volt and ampere. He also expresses approval of the recently adopted definitions, defining the meanings in which the words "inductance" and "reactance" are to be used. He gives a resume of the quantities used in connection with alternating currents, most of which are already well known; among them may be mentioned the following: $\omega = \frac{2\pi}{T}$ called the pulsation or angular velocity of the current, measured in radians per second (radians are numbers for representing angles and are obtained by dividing the arc by the radius), T being the time of a complete period in seconds; u, the difference of potential in volts at any instant t; the subscript *eff* in connection with the letters I, E and U, for the effective values of these quantities; he uses the subscripts s and m with the letter L for self and mutual inductances respectively; ωL_s for reactance of self-induction in ohms; $\frac{1}{\omega C}$ for reactance of capacity in ohms, C being the capacity in farads; $\left(\omega L - \frac{1}{\omega C}\right)$ for the reactance of self induction and capacity expressed in ohms; and $\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$ for the impedance of a circuit in ohms.

Phase Meter.—A paper by Mr. V. Dobrowolski is reprinted in full with illustrations in the "Elek. Zeit.," June 21. After indicating the well-known subdivision of an alternating current into its two components, the effective current and the idle or wattless current, he describes an instrument which is being introduced in Germany for indicating the phase difference; it is really an instrument for measuring the wattless or idle component of the current, but indicates indirectly the phase difference; it not only measures this current but indicates its direction, which is of importance when there is a capacity in the circuit. The apparatus resembles in principle a rotary phase motor and consists of an iron disc pivoted so as to enable it to rotate, containing a spiral spring to bring it to the zero position and provided with a pointer. Around it are placed two fixed coils at right angles to each other, through which the two currents pass; when there is a difference of phase a torque will be produced, which, for a given frequency, is proportional to the product of the currents and the sine of the phase difference; if one of the coils is a fine wire shunt coil and the other a series coil, the instrument will indicate the phase difference between the voltage and the current, and by its direction will indicate which is in advance of the other. If used for the same voltage and frequency the torque will be directly proportional to the idle current; for a small difference in the voltage or frequency the correction will be proportional to the difference. The principal application of the instrument is in central stations with alternators running in parallel, as also in the transmission of power with synchronous motors; when alternators run in parallel there is a current, formerly called a synchronizing current, which it is required to reduce to zero before disconnecting a machine; by means of this instrument it is therefore possible to see whether the alternator is running with any idle current or not, and if so, to indicate when this is zero. A diagram is given showing how this phase meter is introduced on the switchboard for facilitating the connecting and disconnecting of alternators in parallel. In a similar manner, by means of this instrument, the best exciting current can be determined for synchronous motors, thus giving the minimum current in the line wires and thereby reducing the loss in the line to the minimum. In the discussion, Mr. Goerges stated that in his opinion it is preferable to use a wattmeter in central stations in which alternators are run in parallel, as the wattmeter indicates the load on the engine directly; when a machine is disconnected the wattmeter must first read zero; this is the system used with success in a number of installations of the Siemens & Halske Company; he also describes an apparatus consisting of a small electric motor, which acts on the centrifugal governor of the steam engine, reducing the power delivered by the engine without reducing its speed, and used in disconnecting alternators in parallel; he also calls attention to the fact that the phase meter assumes a sine current which is not always correct. In reply, Mr. Dobrowolski believes the phase meter to be preferable for this purpose as it indicates also the direction in which adjustments should be made, while with the wattmeter it is necessary to adjust by trial.

Direct Reading Instruments.—A paper by Dr. Bruger, read before a recent meeting of German electricians, is published in full, together with a number of illustrations, in the "Elek. Zeit.," June 14. He describes some of the recent instruments made by the firm of Hartmann & Braun. The ampere and volt meters are similar in principle to the Weston instruments; the wattmeter differs in principle from the usual form; the construction is shown in the adjoining illustration, which also shows the damping device; by diminishing the cross section of the ring shaped series solenoid toward the ends and by using two fine wire coils, one of

which moves from the middle toward the end, while the other moves from the end toward the middle, a nearly regular scale is obtained; the coils are mounted on agate bearings and the connections are made by means of strips of silver foil, a flat spiral spring acting as the opposing



Direct Reading Wattmeter.

force. To overcome the objections inherent to the spiral spring, he suggests using a quartz fibre, which is stretched in the inside of the coil frame along the centre line of the coil axis, and is so secured that its torsion and its length are adjustable; the self-induction coefficient of the movable coils is about .001 henry; the mutual induction is small as the planes of the coils are parallel and the current circulates in opposite directions in the two coils; the same constant is therefore obtained for alternating as for direct currents. An ohmmeter is described, consisting of two coils at an angle of about 60 degrees with each other, moving in a magnetic field like in a d'Arsonval galvanometer, the polar faces of which, however, are peculiarly shaped, as is also the iron core, so as to produce a field whose density is different in different parts; one form is made for measuring resistance from 10,000 ohms to 1 megohm, but the same instrument can be adjusted for different ranges. A hot wire instrument is also described, modified so as to be used as an ampere meter, the instrument containing a shunt; connections to the wire are made at a number of points so that the different parts are connected in parallel, thus requiring a small difference of potential and therefore a comparatively small shunt; they are constructed for currents up to 500 amperes.

Portable Wattmeter.—A Brillie wattmeter is described and illustrated in "L'Ind. Elec.," June 25. Its principle is the same as usual, it being a zero reading, torsional instrument; in construction it appears to embody a number of improvements; the illustrations explain these; they are constructed to read from 1 to 10 kilowatts.

Mirror Galvanometer.—The London "Elec. Rev.," June 29, contains results of some experiments of Mr. Perkins, showing that it is erroneous to suppose, as is often done, that it is a matter of indifference in what position a mirror galvanometer is set up relatively to the earth's field, and that the needle can always be brought to zero by the adjusting magnet, the sensitiveness remaining the same. The results are given in a table which shows that in two positions the instrument is unstable, it being impossible to bring and keep the spot of light to the zero position on the scale without reducing the sensitiveness considerably; in all other cases the sensitiveness and rate of oscillation could be made substantially the same. Another table is given showing the diminution in sensitiveness when the position of the instrument and the angular position of the magnet were altered, the height of the magnet remaining the same.

Damping.—A mathematical article on the calculation of the damping and the application to galvanometers, from the "Wied. Ann,." vol. 51, p. 156, by Mr. Riecke, is published in "La Lum. Elec.," June 9.

Theoretical Value of the Ohm.—In an Academy paper of Mr. Leduc, published in "L'Elec.," June 30, abstracted in "L'Ind. Elec.," June 25, and mentioned in the London "Elec. Rev.," June 29, he states that the theoretical value is 106.32, which he deduces from a determination of Wuilleumier.

Direct Measure of Electromotive Force.—In an Academy paper by Mr. Limb, abstracted in "L'Ind. Elec.," June 10, and "L'Elec.," June 23, he describes a method for the absolute measurement of the E. M. F. by direct comparison with an E. M. F. of induction, whose value can be calculated; he uses a coil and a permanent magnet revolving in the interior of it; the method and the apparatus are described and some data is given.

Wheatstone Bridge with Alternating Currents.—An Academy paper by Mr. Abraham is published in "L'Elec.," June 30, and abstracted in "L'Ind. Elec.," June 25. He discusses the general cases in which the four arms contain self-induction and the particular case in which one of these self-inductions is zero; if the arms of the bridge are known he shows that the arrangement will enable one to calculate the frequency of the current; some calculated and observed results show a very close agreement.

Synchronizing Clocks for Meters.—In an article by Mr. Jones in the London "Elec.," June 29, he calls attention to an error in meters of the Aron type, in which current is measured by means of the difference in the rate between two clocks; when no current is flowing it is very important that the two clocks should have the same rate, as otherwise they will register a current. He suggests accomplishing this by connecting the two pendulums by a string with a weight attached to its middle point, but as there are attending disadvantages he prefers two small magnets attached to the two pendulums with their unlike poles opposed to each other, their attraction and repulsion will then tend to make the pendulums synchronize; this method is at present used with clocks on about 700 meters of a company in London.

Influence Machine.—In a communication to the French Society of Physics, by Professor Holtz, mentioned in "L'Ind. Elec.," June 25, he claims the priority of invention of the new machine of Mr. Bonetti, as also of the Wimshurst machine, giving references to his first published descriptions.

Rheostat.—The Cance rheostat is described and illustrated in "L'Elec.," June 30; it consists of a spiral of bare wire wrapped around a supporting frame, similar to the old Wheatstone rheostat, and a contact piece which is moved by a crank making contact with any desired point of the wire; the cross section of the wire increases from the high to the low resistance ends.

TRANSFORMERS.

Current Rushes in Transformers.—An article by Mr. Hay on "Impulsive Current Rushes in Inductive Circuits," is begun in the London Elec.," June 29; he investigates theoretically and experimentally the phenomena of the abnormal rushes of current which sometimes occur when a transformer is suddenly switched on to live mains. In the present portion he describes the apparatus which enables him to study the action in detail and trace the various stages through which the current passes before arriving at a steady state; he defines a "current rush" as the ratio of the maximum value reached by the current during any half-wave to the normal maximum when a steady state has been reached; in a comparatively simple mathematical discussion he shows that the current rushes will be greatest when the switch is closed at the instant when the voltage is passing through its zero value and that the current rush, as defined above, must always be less than two; by means of his special switching arrangement, he obtains the actual shape of the current curves, both normal and abnormal; no further results are given in the present portion.

Predetermination of Transformer Curves.—The "Elek. Zeit.," June 21, contains an article by Mr. Korda, on the graphical determination of the current curves of transformers with closed magnetic circuits. The well-known methods of Kapp & Hopkinson assume that certain factors may be neglected and that the specific induction of the iron follows the sine law, which though simpler is not strictly correct. In the present article he gives a general graphical solution of the problem; the article is mathematical in its nature.

Transformer Systems.—The leading editorial in the London "Elec. Rev.," June 29, discusses a system in which transformers are automatically cut out of circuit when not in use; it claims that such a system is only a makeshift and that in good engineering practice the problem is being solved by building transformers having low magnetizing currents at no load, and it believes that transformers exist in which this loss is not more than 1 per cent. of the full load; it is claimed that the scattered small transformer system is a thing of the past and that sub-stations with banked transformers is the correct system.

ARC AND INCANDESCENT LIGHTS.

Arc Lights in London.—According to an official report the number of arc lights used for public lighting in London at present is 479, the length of thoroughfares lighted being thirteen miles; from the number of gas lamps which have been replaced by the electric light, it appears that 2.74 gas lamps are replaced by each arc lamp.

Lewis Arc Lamp.—An illustrated description is given in the London "Elec. Rev.," June 29; the arc is formed and the carbons are fed by the same apparatus, and governed by the same electromagnetic device but the two operations are absolutely independent of each other; a solenoid operates a train of three beveled gears, the feeding apparatus being controlled by a fly escapement, which is locked when there is no feeding.

Cored Carbon Litigation.—The recent decision is given at some length in the "Elek. Zeit.," June 14.

Incandescent Lamp Manufacture.—In the serial of Mr. Bainville in "L'Elec.," he discusses the subjects of the treating of the filaments, the mounting and the production of the vacuum, in the issues of June 9, 23 and 30, respectively.

ELECTRIC RAILWAYS.

Railways and Central Stations.—In a paper by Mr. Hammond, briefly abstracted in the Lond. "Elec.," June 29, he recommends the combination of the power houses of electric railways with the central lighting station; he recognizes that the two loads overlap for a part of the time, and suggests that either accumulators might be used at the station during that time to supply the necessary current in order to level the load line, or that it would be still more economical to use horses for the railways during the overlapping time; in any case he believes that the overlapping difficulty is not insuperable.

Electric Railways in Europe.—According to a paper by Mr. Hammond, abstracted in the London "Elec.," June 29, there are at present in Europe 47 electric roads in operation, the total length being 194½ miles, and the horse power used 14,579.

Budapest Underground Railroad.—A note in the "Elek. Zeit.," June 14, gives some further data about this projected road, regarding the concession but not including any engineering data.

Accumulator Traction.—Some scant data regarding the Sydney line is

given in the Lond. "Elec. Eng.," June 29; Epstein accumulators are used with an output of 20 horse power for five hours.

Wormwheel Gearing.—Some additional remarks regarding the article abstracted in the Digest June 9 and 16, describing Reckenzaun's gearing, are given by Mr. Dawson in the Lond. "Elec. Rev.," June 29.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

High vs. Low Tension.—Mr. Crompton, in a discussion abstracted in the London "Elec.," June 29, strongly advocates the low tension continuous current system in preference to the high tension alternating current system; although the latter requires less capital for the plant this is more than counterbalanced by the higher working costs; he claims that the results in England show this to be the case.

Central Stations in Germany.—A translation of the article mentioned in the Digest June 2, 16, 23 and July 14, together with four full-page tables of data, is given in the London "Elec. Rev.," June 29.

Alternators in Parallel.—See abstract under "Phase Meter."

Bradford.—A paper on the results of four years' working by Mr. Shoolbred, giving a number of curves and tables of data, is reprinted in the London "Elec. Eng.," June 29.

Brussels.—The descriptive article of this station is concluded in "L'Elec.," June 23.

WIRES, WIRING AND CONDUITS.

Insulators.—A novel form of insulator for exposed indoor wiring is described and illustrated in "L'Ind. Elec.," June 10; it consists of a small cylindrical piece of rubber having a transverse hole through it, and a slot enabling a wire to be slipped sideways into this hole; after inserting the wire the insulator is fastened to the wall or ceiling by means of a suitable staple, which encircles the insulator and closes up the gap through which the wire was introduced, thus forming an equivalent of an insulator having a wire passing through a hole through its middle part.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephones in Railroad Service.—According to the "Elek. Zeit.," June 21, the telephone is being introduced largely on the French railroads in place of the telegraph. An Ader microphone, with an iron line wire and earth return, can be used up to distances of 84 miles, but in practice it is not used for more than 30 miles; for this reason copper wires and metallic returns are introduced, the wires being crossed about every 1,600 feet; on the main lines one-quarter of the service is done by telephone, while on many smaller lines the telephone is used exclusively.

Telephone Induction Coils.—Mr. Piérard, in a recent paper on the rendering of telephone induction coils, mentioned in the London "Elec. Rev.," June 29, concludes from experiments, that the rendering of such coils for telephone currents does not vary appreciably with the charge and that the rendering is small and does not appear to reach 50 per cent.

Simultaneous Telegraphy and Telephony.—The Pickernell system is described and illustrated in "La Lum. Elec.," June 9.

ELECTRO-CHEMISTRY.

Electro-Chemistry.—An interesting paper by Professor Ostwald, entitled "The Scientific Electro-Chemistry of the Present and the Technical Electro-Chemistry of the Future," read at a recent meeting in Germany, is published in the "Elek. Zeit.," June 14, a full abstract being given in the London "Elec.," June 29, in which journal it is also discussed editorially and is commented on in the editorial notes. He points out the advantages of a scientific education, claiming that the education of the engineer should be the same as that of the professor and that it is only at the completion of his studies that the student needs to decide which vocation to follow; he believes that the success of the chemical industry in Germany is due to the fact that it is appreciated there that "science is the best practice." He discusses the subject of electrolytes from a theoretical standpoint, and states that in every electrolyte the conductivity is proportional to the number of ions per unit of volume and depends furthermore on two constants, which might be called the velocity of propagation of the ions; the latter is greatest with hydrogen. If a layer of water is poured over a concentrated solution of salt, diffusion will take place until the whole mass is equally concentrated; the cause of this motion, which has the property of a pressure, he calls the "osmotic pressure"; it can be surprisingly great in a solution of salt, like in seawater, a pressure of 20 atmospheres can be obtained; for each material there will be a maximum of this pressure, which will depend on the solubility of the solid body; this pressure is quite analogous to steam pressure, and just as steam pressure can be used to drive an engine, so can osmotic pressure be caused to drive a corresponding machine; he defines a galvanic cell as nothing more than a machine driven by osmotic pressure; the zinc, for instance, is dissolved, forming zinc sulphate; the voltage of a Daniell cell depends on the difference between the osmotic pressures of the zinc and the copper ions; for each metal this pressure, which he calls dissolving pressure, is a perfectly fixed quantity, but a cell does not depend on this alone, but also on the liquid, as for instance on the concentration. He calls attention to the very poor efficiency of the transformation of the energy of fuel into mechanical energy, saying that in the very best case the efficiency is only 10 per cent. He points out the great field for improvement and believes the problem must be solved by electro-chemistry. He describes the following experiments, showing that some of the views held are quite erroneous: Two vessels containing sulphate of potassium are connected by a U tube, one contains an electrode of zinc and the other one of platinum; no current is obtained until acid is added, but it is generally believed that the acid should be added to the vessel containing the zinc, which should be dissolved by the acid; he shows that this is erroneous as no current is obtained under those circumstances, while if the acid is poured in the vessel containing the platinum a strong current is obtained; in this connection he shows that Jablochkoff's recent experiment, in which he obtained a current from the direct combustion of carbon in a battery, was based on wrong principles; he places the carbon in fused saltpetre, and the failure of the experiment is claimed to be due to the fact that the saltpetre should not be placed around the oxidizable electrode, but around that one which is not attacked by the oxygen; in the future carbon cell the oxidizing material will not be placed around the carbon, but around the other pole; in a cell of this sort the chemical process will be the same as in an ordinary stove; what is still wanting is a suitable electrolyte which will merely act as a medium, but will not be consumed; he believes that the solution of this problem is not impossible. Regarding the question of the storage of electrical energy, he shows that if aluminium could be used the weight of an accumulator would be only one-eleventh of that of the lead accumulator but he does not believe that the aluminium accumulator will ever become a practical one. Regarding electrolysis, he does not recommend separating the reactions into primary and secondary, as is often done. In an editorial mention of this paper in the Lond. "Elec.," it is stated that a carbon cell, such as that referred to, should yield theoretically nearly 6 h. p. hours or 4 kilowatt hours per pound of carbon.

Aluminium.—A paper by Mr. Verrier on the present state of the aluminium industry is published in "L'Elec.," June 30, and abstracted in "La Lum. Elec.," June 9. He states that it is hardly probable that the price of this metal will fall below 36 cents per pound when it is made by electrical processes, but that it is possible that cheaper chemical processes will be found; he calls attention to the process based on the reduction of the sulphide of aluminium. (In this conection the compiler calls attention to the fact that there exists a primary battery in which metallic aluminium is obtained as a by-product; possibly some development might be expected in this direction.)

Decomposition of Water.—The Lond. "Elec. Eng.," June 29, mentions a paper by Mr. Leblanc, in which he upholds the view of the primary decomposition of water.

Polarization.—An explanation of the phenomenon of polarization by Mr. Wiedeburg is given in the Lond. "Elec. Eng.," June 22.

MISCELLANEOUS.

Concentration of Sulphuric Acid.—An editorial in the Lond. "Elec. Rev.," June 29, calls attention to a paper in the "Chemiker Zeitung," vol. 17, p. 1,907, in which it was shown that in using the direct current electrolysis took place, producing sulphur and sulphuretted hydrogen; much better results were obtained by using the alternating current; 190 grams of sulphuric acid at 60 degrees C. were concentrated to 65.8 degrees, with a loss of 35 grams in 3.25 hours, the temperature rising and remaining at 286 degrees C; no visible sulphur was deposited; the current was transformed down to 6 to 7 volts and 14 amperes, and the energy consumed for 155 grams of concentrated acid was 296 watt-hours, or 1,490 per kilogram.

Tempered Copper.—"La Lum. Elec.," June 9, extracts from a recent book by Mr. de Rochas a description of the process used by the ancients.

Electric Log.—A translation of the article mentioned in the Digest, June 30, describing Fleuriais's log is published in the Lond. "Elec. Rev.," June 29, including the illustrations.

Biographical.—The death of Edmund Carré is announced in the French journals; short biographical notices are given in "L'Ind. Elec.," June 25, and "L'Elec.," June 30; he was the first to manufacture electric light carbons as usually made by the process invented by his brother, Ferdinand Carre.

Photography.—In color photography the hygrometric state of the plates has an important influence on their sensitiveness; according to "La Lum. Elec.," June 9, a French photographer has obtained good results by an electric process of heating the plates.

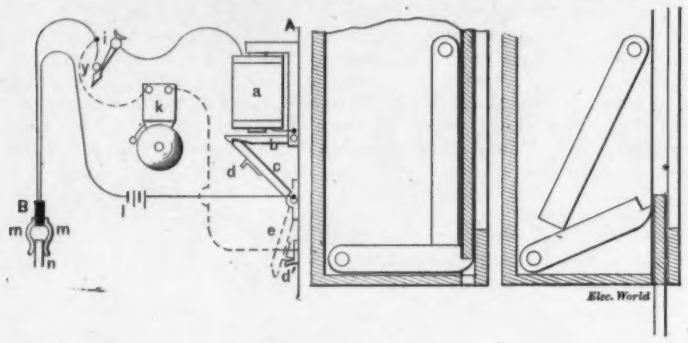
A Simple Fire Alarm.

A New York village of some 9,000 inhabitants (Peekskill), desiring to install an inexpensive system of fire alarm, the apparatus described below was devised by Mr. Louis Miller, Superintendent of Fire Alarms, for this purpose and installed at small cost. The contract with the village required five miles of line through eight districts and connecting the houses of five hose companies, the electric light station, at which there was a whistle to be used for night alarms, and a planing mill where there was a whistle to be used for day alarms; in all 47 signal boxes were required. For indicators, needle annunciators were employed. To ring the local bell it was intended to have the needle close the circuit by contact with its attracting magnet; but this was found to be impracticable and a special instrument, shown in Fig. 1, was designed. It consisted of an electro-magnet, a, and its frame attached to a bar, A (the side of the annunciator), an armature, b, lever, c, pivoted to the base independently of the magnet and armature, and a spring, d, independent of the other devices. The operation of the several parts will be plain. Even a slight impulse through the magnet, a, would lift the armature, b, allowing the lever, c, to fall, and in falling press its spring, d, in contact with spring, d'.

The arrangement of the circuit was as follows: I represents the needle

of the annunciator, and y its attracting magnet, k is the local bell, l the local battery; B is a hard rubber handle furnished with springs, m m, and suspended by flexible cord from the ceiling just over the fire apparatus. The springs, m m, are clasped over some metallic part of the hose carriage, represented by n.

An alarm would cause the needle, i, to make contact with the magnet, closing the local circuit through them, allowing it to pass over the circuit represented by a solid line, through the magnet, a, out of the magnet into the magnet frame and armature, b, through the line, c, thence to the battery. The result would be the dropping of the lever, c, causing it



Figs. 1, 2 and 3.

to make contact with the spring and changing the course of the circuit, cutting out the needle and magnet, a, establishing the circuit through the broken line, which includes the bell, k.

Moving the fire apparatus from its place will cause the handle, B, to swing clear, which will open the battery circuit, there being no longer any occasion for ringing the bell. On the return of the apparatus the annunciator must be tripped before the other instruments in circuit can be reset.

Fig. 4 is an illustration of the signal box. It measured five inches high, three and one-quarter inches wide, and two inches deep. The sides and back were integral and all the box of cast iron. The front was held to the box by a single screw set in from the back, so that when the box was fastened in place with staples over the pipes, the box could not be opened. The front had a hood over the hinge of the drop cover to shed water.

The open front under the drop cover was closed by a plate of glass, inserted by pushing it up through a slot at the bottom, provided between

Fig. 4.—Signal Box.

the front and the box, as shown in Figs. 3 and 4. The glass was easily inserted, but could only be removed by breaking it. Fig. 4 shows how a pair of levers pivoted to the side of the box were manipulated to insert a glass. The lever, a, was pushed back so the lever, b, would yield to the pushing of the glass. When the glass reached its topmost limit the lever, b, would be released and would fall to a horizontal position with its joint under the glass. At the same instant the lever, a, would fall to a vertical position and lock the lever, b, as shown in Fig. 3. The drop front was lettered with directions, thus: "Raise Cover, Break Glass, Press Key."

Within the box illustrated the rubber button of a key is visible. It is a brass key lever, having connection with the insulated wire passing out the pipe at the top of the box. The pipe extended above the box far enough to guard the wire from being tampered with. The key made contact with a spring connected to the pipe attached to the bottom of the box. This pipe extended several feet into the ground, and constituted the "ground" for most of the boxes, although to get a good ground for some of them it was necessary to bury copper plates. The wire from the box extended up the poles to the line, to which it was thoroughly soldered. In the preliminary tests fifteen cells of battery were used, but when put in operating trim the main battery was made to consist of forty cells.

The system worked admirably, the chief objection to it being that the glass of the boxes was frequently broken by mischievous boys and false alarms sent in. This, of course, could be easily remedied by having locked boxes.

The Hamilton Elevator.

The great extent of space required by the present elevator systems in which a single elevator car, while occupying but a few feet vertically,

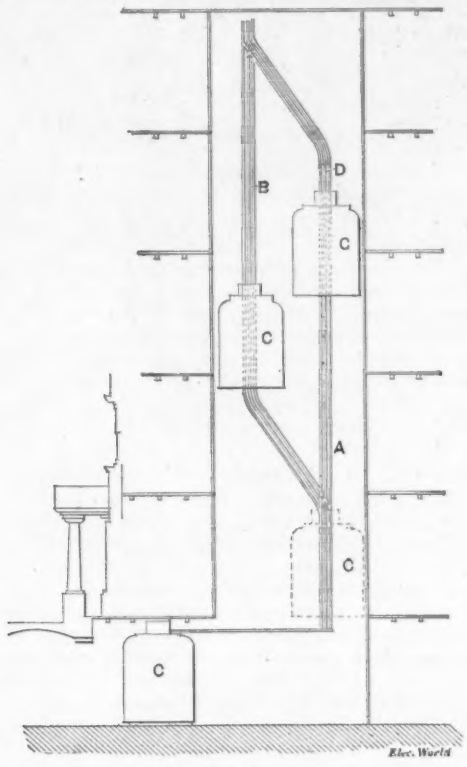


Fig. 1.

monopolizes a shaft running from top to bottom of the building, becomes a serious question in modern office buildings when size compels the use

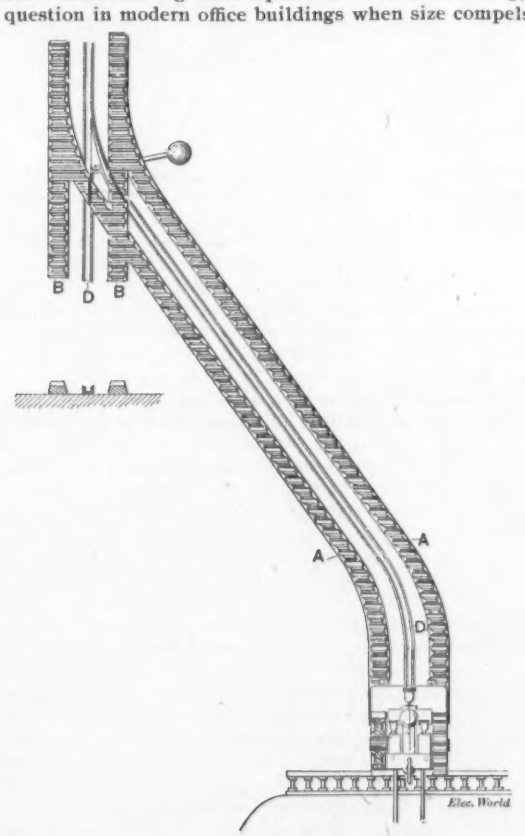


Fig. 2.

of a great number of cars to properly supply the public. Annoyances, perhaps not so serious as the loss of space, but still material, are involved,

though indicators be used, in the confusion resulting from the same shaft having at one time an up-going and the next a descending elevator car. It would obviate all of these annoyances to have all up-going cars in one shaft and all descending cars in another. And the great height of the modern office building allows the adoption of such a method of operation without changing the speed or headway of the cars as they are at

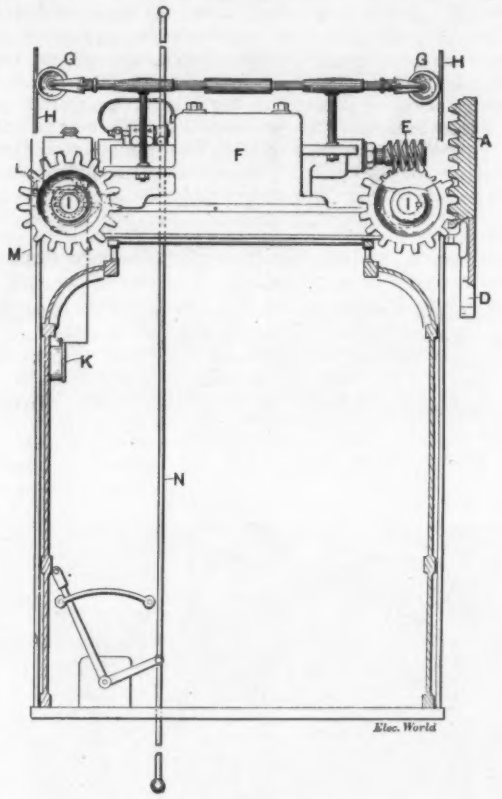


FIG. 3.

present operated. In the system which we illustrate, the invention of John R. Hamilton, 831 East 170 street, New York, the cars all travel up one shaft, and are at the top automatically shifted without stoppage to an adjoining shaft, whence they descend to the lower or ground floor, where they are in a similar manner transferred to the up-going shaft. In

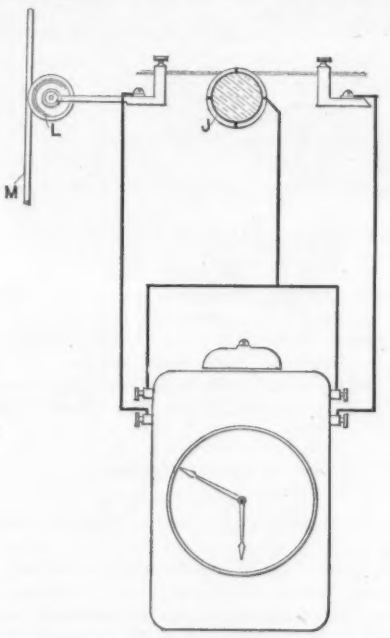


FIG. 4.

each car is an indicator which shows the operator the exact position of the neighboring cars, but sole dependence is not alone placed upon the alertness of the attendant. Electric stopping devices are employed to entirely prevent the possibility of accident from collision. It is found that with ordinary speed, headway and number of cars by the use of this system, two elevator shafts will give the same service as five or more operated according to the old plan, with a large saving in horse power required and great increase of convenience and efficiency in serving the public.

The system, besides, is applicable to freight and mining elevators as well as to passenger elevators, and in its application to mines may be made a valuable adjunct to the mine ventilating devices if the ascending and descending shafts be boxed off so that the elevator platforms will act as air pistons. In the accompanying illustrations Fig. 1 is a view in elevation of an elevator operating on the Hamilton system. Separate racks, A and B, are provided, the former for ascending, the latter for descending cars, C. At top and bottom the racks and the guide tracks, D, are inclined to direct the cars from one side of the shaft to the other. Fig. 2 represents the automatically operating switches for effecting their shifting movement. Fig. 3 shows the mechanism at the upper part of the car. Worm gears, E, are operated by an electric motor, F, which takes current by trolleys, G, from wires, H. The worms on the two sides of the car are pitched in opposite directions, thus doing away with end thrust of shaft. On the countershaft, I, is arranged a circuit breaker, J, connected to the indicator, K, of its own car and by trolley, L, and wire, M, with the indicator of the car ahead. The divergence of the indicator arrows shows the distance in feet or time of the car from the car next ahead, so that the elevator men can maintain a substantially even headway between the cars. A rod, N (Fig. 3), extending both above and below the car, controls the rheostat lever and so governs the motor, promptly stopping the car if it approaches too near another one.

A Diminutive Battery.

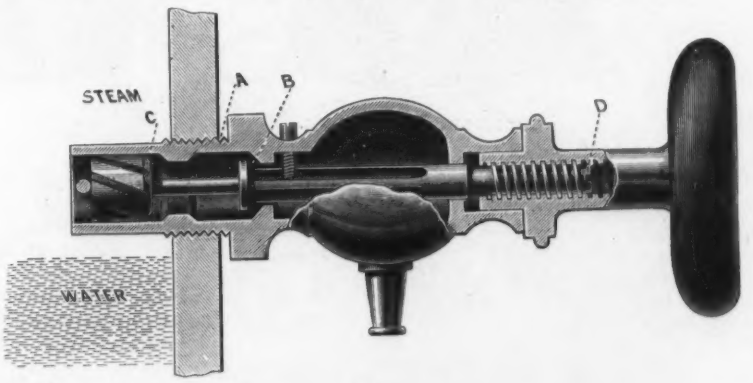
The limit of "multum in parvo" in primary batteries appears to have been reached by the Nassau Electrical Company, 106 Liberty Street, New York, in its new "Capo-Farad" sealed battery, as improved by Mr. J. J. Pearson, manager of the company. The problem of high efficiency, com-

DIMINUTIVE BATTERY.

bined with mechanical reliability and small weight and dimensions, is a very important one, and this cell, shown in the accompanying illustration, which at 1-10 volt yields a current of two amperes, and is only a little over ⅝ inch in diameter, less than 2¾ inches long, and weighs less than one ounce, seems to have solved the question very satisfactorily.

Safety Automatic Gauge Cock.

The gauge cock illustrated, manufactured by Frank M. Ashley, 136 Liberty street, New York, is especially adapted to locomotive and portable boilers, and screws into the boiler or water column as shown. The sectional view shows two valves, and two valve seats in the cock, one behind the other; one valve is cast with the central stem as shown, having a pin projecting from its centre, designed to strike against the face of the second valve. The operation is as follows: Steam being on



AUTOMATIC GAUGE COCK.

the boiler, the pressure forces both valves to their seats, as shown. To open the valve the handle is turned from right to left, which advances the central stem; then, by pushing the handle in toward the boiler the latter slides inward, forcing the first valve from its seat a short distance, while the pin attached to the back of the first valve strikes the face of the second valve and forces it from its seat. The steam then flows through the spiral wings of the second valve and through the first valve into the atmosphere, causing the second valve to rapidly revolve, and by its action on the spiral wings or flanges cuts loose all scale or sediment which may have lodged in the valve chamber, which is carried off by the steam blowing through. When the engineer lets go of the handle the pressure of steam instantly forces the valves to their seats, but as the second or flanged valve comes to its seat a little before the first valve, and as it is being rapidly rotated by the action of the steam on its flanges, it strikes the seat while revolving and regrinds the valve seats lightly

each time the valves are closed. Another feature is the arrangement of the second valve and its seat. Suppose the gauge cock should be broken off of the boiler by a blow, it would of course break just outside of the boiler sheet, the weakest part, which would leave the second valve within the boiler closed, and consequently the engineer would not be scalded, and if it should happen when his engine was running, he would not have to stop, as it would otherwise be necessary. A screw fits into the groove of the central stem and keeps the stem from revolving. After the valves have automatically closed by the pressure of steam the engineer can screw up the handle which draws the first valve to its seat, so that it cannot be accidentally forced open by being pressed against.

New Telephone Apparatus.

In the accompanying illustration is shown the telephone which the Columbia Telephone Manufacturing Company, 136, 138 and 140 Front street, New York City, is placing upon the market. The instrument is manufactured under the patents of Jas. W. McDonough, H. H. Eldred and other pioneers in the telephone field, and "non-infringement" is one of the strongest claims of the company. The receiver, it will be seen from the cut, is somewhat more compact than the ordinary form, and the connections are made inside the rubber shell, avoiding here, as well as elsewhere on the instrument, the exposure of unsightly thumb screws. A multiple contact carbon transmitter is used, consisting of a series of pencils resting on bearings and having their bearing points rose shaped so as to afford a number of sharp contact points. The carbons are attached to the under side of a thin wooden diaphragm, against which the speaker's voice is directed.

Columbia Telephone.

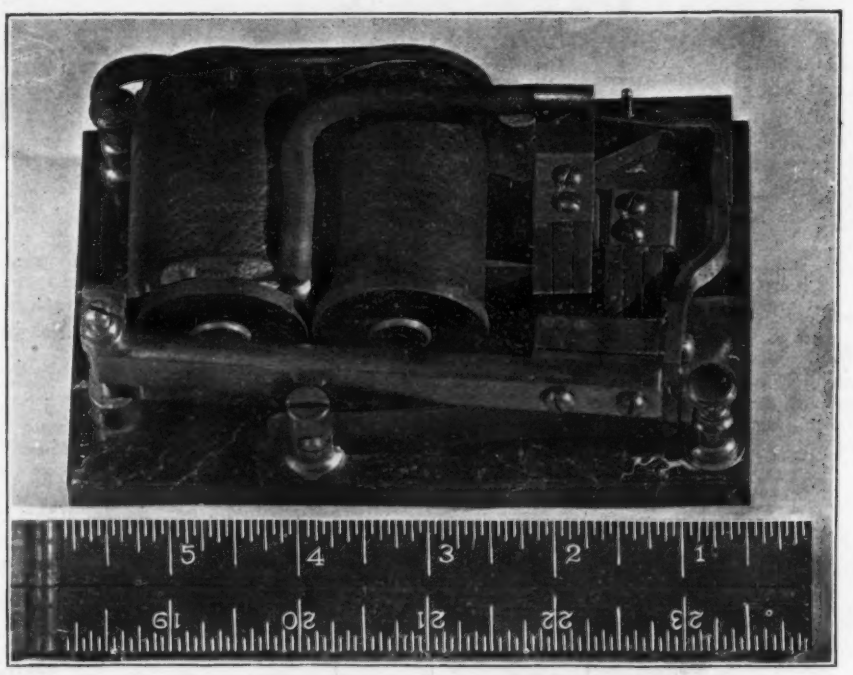
One of the interesting features is the battery switch. The receiver, when not in use, is suspended on a hook, at the top of which the switch is placed. When the receiver is suspended on the hook an alarm bell rings and can only be stopped by throwing the switch over, a movement which cuts out the battery and prevents its running down. A dry battery is employed. The company is also to bring out in the near future an automatic telephone exchange, by which the subscriber can place himself in connection with any other subscriber, and the ordinary switch board and telephone girl be dispensed with. The means of accomplishing this is exceedingly simple; two electro-magnetic operating ratchets by the attraction of their armatures, secures the necessary movement The apparatus is positive in its action and so simple that it requires little or no attention. In the first form the subscriber made his connections by depressing keys marked "hundreds," 'tens," "units" and "release," respectively; by an ingenious device of Mr. H. H. Eldred, the keys have been replaced by wheels projecting slightly above the containing case, and whose corrugated rims permit them to be easily revolved by the hand, while at the same time figures plainly indicate to the eye whether connection is being made with the proper number. Such an automatic switchboard would find its greatest field of application in the smaller cities and towns, in factories, offices and other places, where the number of subscribers is not sufficiently large to warrant the presence of a day and night central exchange operator.

Trolley Wheel.

A new design of the Westinghouse type of trolley wheel, in which oil is used as a lubricant for the steel spindle in addition to the graphite bushing, is being manufactured by the Ohio Brass Company, of Mansfield, Ohio. The centre of the hub of the wheel is hollowed out around the graphite bushing and the recess filled with felt packing. Holes are provided so that the felt may be kept saturated with oil, which in turn feeds through the bushing to the spindle, keeping the graphite moist and lubricating the bearing thoroughly. It is advisable that a few drops of oil be poured into the oil well every few days. It is claimed that this adds fully 25 per cent to the life of the wheel. The wheels are made from extra hard quality bronze metal and proportioned so as to give the longest possible wear. They are balanced and trued, and in consequence will run smoothly on the trolley wire.

An Automatic Switch for Charging Storage Batteries.

One of the most important adjuncts, if not the most important, to a storage battery plant, is the automatic charging switch, for the most serious results would occur if this instrument should refuse to act at the critical moment. The Electric Bell and Resistance Company, Newark, N. J., has recently placed on the market a new form of automatic switch for this purpose, illustrated herewith, which is claimed to be absolutely reliable, and specially adapted where there are great variations in the voltage of the charging source. The action of this switch is positive and reliable, closing the circuit at any set voltage and opening it when the charging current falls to nearly zero or before it can commence to flow in a reverse direction.



Automatic Storage Battery Switch.

Electric Heating.

A patent has been issued, under date of July 10, 1894, to Mr. H. Ward Leonard, for an electric heater which involves quite a radical change from present practice. The device is perhaps best explained in the first claim of the patent, which reads as follows: "A device in which electrical energy is converted into heat, having a thinly insulated conductor embedded in and completely surrounded by a closely applied mass of metal."

One of the objections to electrically heated tools hitherto has been that the conductor was surrounded by a considerable thickness of fireproof insulation made of various materials which are bad conductors of heat, and the heat developed in the resistance is conducted but slowly through this bad conductor. The conductivity for heat, however, through such insulation would be greatly increased by means of strong mechanical pressure. Another great difficulty has been the gradual deterioration of the heated resistance because of its oxidation by more or less perfect contact with the air through the intervening insulation. The necessity of a resistance which would stand a very high temperature has been such that platinum wire is often used in the construction of electric tools, the

expense of which is of course extremely high, but even this has failed under such conditions.

Mr. Leonard has many modifications of the general principles of his invention, but the description of one modification will give a general idea of the invention: The resistance, which is a metal wire, is thinly coated with some form of fireproof insulation which hermetically seals the conductor from the air, such as enamel or glass. The wall of insulation around the conductor is quite thin. The conductor so insulated is placed in a mould, and a suitable metal is cast about the insulated resistance so as to completely embed it in the cast metal. This surrounding body of metal as it cools subjects the insulated conductor to strong pressure, insuring perfect mechanical contact throughout. The surrounding metal also hermetically seals the resistance from any possible contact with the air and from all chemical action. While the insulation surrounding the conductor is of comparatively poor quality as a conductor of heat, the wall of this insulation is so thin that it affords the least possible resistance to the flux of heat from the heated resistance of the surrounding metal body, consequently the temperature of the heated resistance and the temperature at the surface of use will be as nearly the same as possible, and the resistance is therefore not subjected to a temperature appreciably higher than that of the surface of use.

It is possible to operate tools heated by the Leonard system at a bright red head without any destructive effect whatever, and this possibility opens up a wide field for the application of electricity to various tools used in the various arts and industries which have heretofore necessarily been heated by gas, charcoal stoves, etc. The Carpenter Enamel Rheostat Company, of which Mr. Leonard is president, will manufacture apparatus under this patent.

Among the various kinds of apparatus which will soon be on the market due to this invention are the following: All kinds of soldering irons and embossing irons, all kinds of flat irons and tailors' gooses, all kinds of cooking utensils, such as chafing dishes, broilers, griddle cake bakers, coffee pots, electric stoves, electric ovens, egg boilers, etc ; also many applications to small appliances such as curling irons, sealing wax heaters, etc. Also all kinds of atmospheric heaters such as street car heaters, and heaters for dwellings where the cost of electric current is sufficiently low to make it possible for electric heating to compete with fuel directly. In this regard Mr. Leonard estimates that where power can be had, which does not cost more per horse-power per annum than the cost of two tons of good coal, electric heating can compete on the score of economy alone with heat from fuel direct, and the many advantages of electric heaters are so pronounced that they will frequently be applied for atmospheric heating even though the actual direct cost be much greater than that due to heating by fuel.

Portable Alternating Current Meter.

A portable instrument, by means of which accurate measurements may be made of alternating currents, is now being placed upon the market by

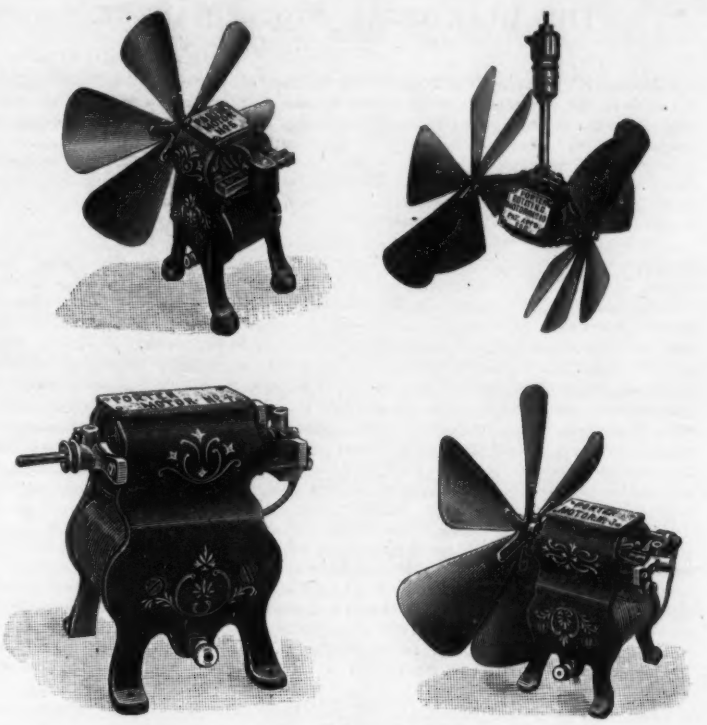
ALTERNATING CURRENT METER.

the General Electric Company. It is small and handy, and combines strength, permanency and reliability with compactness of form and excellence of workmanship. The scale is unusually long and reads to fine divisions. The instrument, although designed for alternating current measurements, may also be used for measuring direct currents, but for this work it requires special calibration. It is made in 25, 50, 100 and 200 ampere sizes.

Small Motors.

It is but a few years since small motors have been made with any efficiency worth speaking of, and among the first who considered the question of economy worthy of study was the Porter Standard Motor Company, now at 35 Broadway, New York. We illustrate herewith some of the latest types of motors manufactured by this firm, including a double rotating overhead ceiling fan motor recently placed on the market.

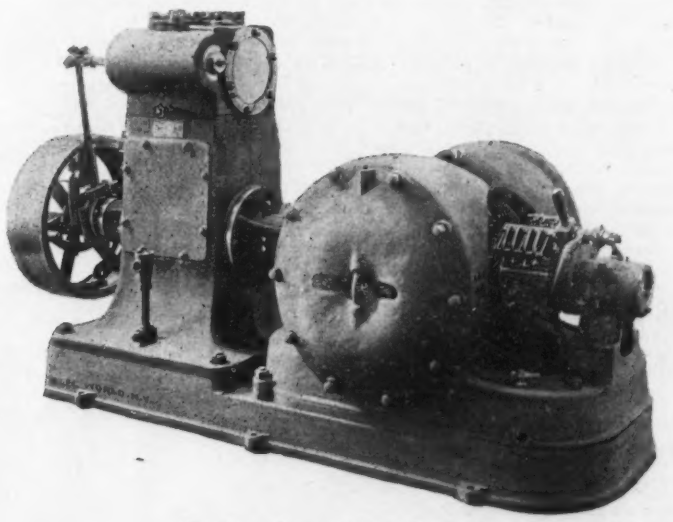
In order to obtain the best results, a fan motor should be so constructed as to run continuously without attention, and circulate the air in such a manner as to produce the needed relief without discomfort. This is accomplished in the double fan rotating motor, which, if suspended from the ceiling in the centre of a room 40 feet square, will, it is claimed, keep the air in motion in all parts of the room without creating uncomfortable drafts, even in close proximity to the motor, and yet have an effect in the remotest corner. This motor is particularly applicable for use in cooling the cabins of steamships and yachts, and also for ventilating the holds of vessels. It weighs about fifteen pounds, is self-lubricating, and will run continuously for a whole season without any care. It has 12-inch aluminium fans, and runs at 2,000 revolutions per minute on a 110-volt circuit, requiring, it is stated, less than one-half ampere of current to operate it.



SMALL MOTORS.

Wenstrom Direct Connected Outfit.

The demand for direct coupled apparatus, especially for isolated plants, is constantly increasing. The greatest hindrance to its introduction in the past has been the high speed at which it has been necessary to drive



DIRECT CONNECTED OUTFIT.

the generator. The Wenstrom Electric Company has devoted special attention to the solution of this problem, and its new outfit, an illustration of which is shown herewith, practically eliminates this difficulty. The Wenstrom dynamo has been familiar to the public for some time and its excellence of construction and high efficiency are well known. A glance at the accompanying illustration will show how admirably it is adapted for direct connection. The dynamo is of multipolar construction and will run successfully at a low rate of speed, for which the Wenstrom Company makes a special claim. The company has recently subjected a 15 kw. outfit to a test which proved very successful and showed good results. Mr. Henry B. Oakman, 136 Liberty street, New York, is the general Eastern agent for the Wenstrom Company.

Financial Intelligence.

The Electrical Stock Market.

New York, July 14, 1894.

THE ELECTRICAL STOCK MARKET has shared with the other speculative markets in the stagnation of business that has resulted from the paralysis consequent upon the big Western labor troubles. While having no direct bearing upon the electrical industry, the strike has completely killed all demand, either for manufactured articles or for securities, and, while large bank funds now on hand after the large July dividend and interest disbursements have sought some temporary investment in securities, the demand is nothing like that which occurs at this period in normal years.

GENERAL ELECTRIC has been the strongest of the low-priced stocks, and, in a market where transactions have been generally absolutely lacking in significance, has been freely taken the last few days by a new pool that has of late been absorbing the floating supply of stock. With the beginning of operations of this pool have naturally appeared a lot of reports tending to increase confidence in the company and to inspire further belief in its renewed march of prosperity. Thus, at the beginning of the week, it was bruited that negotiations were pending between the Manhattan Elevated Railroad Company and the General Electric Company for a plant to take the place of steam motors on the New York system, and though it was afterwards announced that the Manhattan Company had decided not to adopt electricity as a motive power, because of the expense of $8,000,000 involved in making the change, the story had sufficient circulation to strengthen General Electric's quotation. Then it was announced that the General Electric has of late managed to create a demand of large dimensions for power motors from shoe manufacturers in the East, owing to the prevailing disposition among them to save on labor and other details wherever practical, and the opening of this new field of profit has led to calculations as to how General Electric apparatus will be used to great advantage in many industries, thereby assuring a large business to the company. As a result of all these encouraging reports, quite a tone of strength is lent to the stock. But the market is very narrow, and there is no telling how far or how little quotations reflect anything but the manipulation of interested members of some pool or another.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK furnishes The Electrical World, through Treasurer Joseph Williams, some figures of comparative earnings for June, and for the six months ended June 30, 1894. Gross earnings for June were $101,351, an increase of $15,740; net earnings were $52,504, an increase of $18,305. For the six months gross earnings were $687,754, an increase of $77,899, and net earnings were $375 644, an increase of $93,341. With these evidences of prosperity the stock holds very firm.

THE BROOKLYN EDISON ELECTRIC ILLUMINATING COMPANY reports comparative earnings for June as follows: Gross earnings, $24,004, an increase of $3,598; expenses, $17,822, an increase of $4,526; net earnings, $6,182, a decrease of $928; other income, $5,604, an increase of $4,417; amount applicable to dividends, after deducting $2,100 for interest due on bonds, $9,686, an increase of $3,489. The expense account of June, 1894, carries the operating expenses of five weeks, and in addition about $800—incurred in preparing for and lighting on the city contract, from which no revenue appears until July. Net earnings of six months have been: 1894, $96,470; 1893, $72,595; 1892, $43,641; 1891, $22,615.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES' trustees have, as intimated in these columns last week, purchased, according to agreement, 608 more shares of preferred stock at 97⅛, making the total purchased to date, 12,551 shares. The value of the securities obtained from the General Electric Company and held in the trust is every day being more fully established.

WESTINGHOUSE ELECTRIC issues, with the exception of a good demand for the preferred noted in Boston in the last day or two, have been very quiet, but quotations are very well held on the reports of continued good business.

AMERICAN BELL TELEPHONE stock holds very firm. The Board of Directors of the company held a meeting this week, but it was announced that nothing but routine matters were considered. This, together with the fact that Mr. Hudson, president of the company, is going to Europe, gives rise to the impression that nothing will be done just at present in the matter of issuing the $30,000,000 new capital stock authorized by the Massachusetts Legislature to be sold at auction. But nothing official relative to the matter is made public.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric Co.	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
* Edison Electric Ill., New York	100	100	100½
* " " " Brooklyn	100	100	102
" " " Boston	100	116	115
" " " Chicago	100	135	145
* " " " Philadelphia	100	128	130
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com	15	15	17½
" " " " " " pref.	15	15	17½
Fort Wayne Electric	100	1	2
General Electric	100	37⅛	37½
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35	36
" " pref.	50	50½	51½

BONDS.

Edison Electric Ill., New York	1,000	106½	107
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	86¼	86½

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	195	196
American District Telegraph	100	—	45
American Telegraph & Cable	100	89½	90
Central & South American Telegraph	100	105	110
Commercial Cables	100	125	—
Gold & Stock Telegraph	100	100	102
* Mexican Telegraph	100	190	200
* Western Union Telegraph	100	84⅝	84¾

* Ex. div.

ERIE TELEPHONE AND TELEGRAPH stock has enjoyed some bit of life on the announcement that the telephone service in all its divisions is to be greatly extended.

FORT WAYNE ELECTRIC stock has been higher this week on the belief that the company will yield more in liquidation to stockholders than has been expected. The receivers are making an effort to present at an early date some statement of its affairs.

WESTERN UNION TELEGRAPH has been very firm all week and shorts have been rendered very nervous on finding that the amount of offerings has been largely reduced by the withdrawal from the street of certificates bought by actual investors. The $550,000 additional stock listed on the New York Stock Exchange this week was issued for the purpose of the American Rapid Telegraph Company, which had previously been operated by the Western Union on a lease, but which was purchased under foreclosure on March 11, 1891, by a committee of bondholders, and then resold to the Western Union. With the $500,000 received from the Western Union and with $300,000 in the receiver's hands, the bondholders of the Rapid Telegraph Company will receive a dividend of about 27 per cent. on their $3,000,000 bonds. The $3,000,000 common stock is frozen out. The Rapid Telegraph has 20,370 miles of wire extending from New York city to Boston, Buffalo, Cleveland, Pittsburg, Chicago, Washington and intermediate points, and before being sold to the Western Union was leased to it by the receiver at a rental of $60,000 per year. Dividends of 5 per cent. on $500,000 call for but $25,000 per year, so that the purchase saves the Western Union $35,000 a year.

New Incorporations.

THE JOSEPH TELEPHONE COMPANY, Joseph, Ore., capital stock $500, has been incorporated.

THE MURPHY POWER COMPANY, Chicago, Ill., capital stock $3,000, has been incorporated by S. M. Murphy and others.

THE SPENCER MOTOR COMPANY, Glastonbury, Conn., capital stock $2,000, has been incorporated by S. P. Turner and others.

THE ECONOMIC LIGHT, HEAT AND POWER COMPANY, Snohomish, Wash., capital stock $25,000, has been incorporated.

THE LITTLE CYCLONE FAN COMPANY, Kansas City, Mo., capital stock $10,000, has been incorporated by W. P. Waite and others.

THE ELECTRIC BRUSH PORTRAIT COMPANY, San Francisco, Cal., capital stock $10,000, has been formed to make portraits, frames, etc.

THE BRODIE ELECTRIC COMPANY, Manchester, N. H., capital stock $25,000, has been formed to manufacture electrical apparatus, etc.

THE FREEPORT ELECTRIC COMPANY, Freeport, Ill., capital stock $150,000, has been incorporated by R. S. Brown, J. B. Taylor and Geo. H. Currie.

THE BLUFF CITY ELECTRIC STREET RAILWAY COMPANY, Waukegan, Ill., capital stock $200,000, has been incorporated. The promoters are DeWitt L. Jones, S. D. Talcott and Chas. Whitney.

THE TRACTION CONSTRUCTION COMPANY, Denver, Col., capital stock $50,000, has been incorporated by Geo. E. B. Hart and others to construct and operate electric and cable railways, street railways and tramways.

THE LITTLE CYCLONE FAN COMPANY, Kansas City, Mo., capital stock $10,000, has been formed to operate electric fans, etc. The organizers are W. T. White, F. E. Weidman and Wm. W. McCall, Kansas City, Mo.

THE NASH-EDDY COMPANY, Cleveland, O., capital stock $12,000, has been formed to manufacture and deal in all kinds of mechanical and electrical apparatus, devices, etc. Nathan E. Nash, Geo. A. Eddy, F. G. Botsford, H. W. Wolcott and L. H. Winch.

THE FIRE AND POLICE TELEGRAPH COMPANY, Louisville, Ky., capital stock $50,000, has been formed to deal in electrical machinery, apparatus and supplies, and to do general electrical business. The promoters are C. A. Ray, W. S. Hogue and H. C. Stancliffe.

THE PEOPLE'S GAS AND ELECTRIC LIGHT COMPANY OF SARATOGA SPRINGS, Saratoga Springs, N. Y., capital stock $75,000, has been formed to manufacture and supply gas, electricity and other lights. Chas. H. Moore, H. Carpenter and Warren Dake, Saratoga Springs, are the incorporators.

THE ELBRIDGE ELECTRIC MANUFACTURING COMPANY, Elbridge, N. Y., capital stock $10,000, has been formed to manufacture and sell electrical apparatus and engines, boilers, etc. Wm. C. Ranney, L. B. Doman, A. E. Doman, Elbridge, N. Y., and A. Blair Frazee, Kipple, Pa., are interested.

THE NORTH AND SOUTH ELECTRIC RAILWAY, Yonkers, N. Y., capital stock $50,000, has been formed to operate a street railway in Yonkers, either by electricity or horse power, or both, the road to be five miles long. W. D. Baldwin S. T. Hubbard, Jr., J. C. Shotts, J. J. Devitt, T. H. Silkman, J. S. Fitch, L. M. Saunders, W. E. Hodgman, Yonkers, and R. B. Kelly, New York, are interested.

Special Correspondence.

Western Notes.

Branch Office of The Electrical World
936 Monadnack Building, Chicago, July 14, 1894.

JOHN R. MARKLE, whose name is familiar to our readers, has been placed in charge of all the Western business of the Electric Storage Battery Company, of Philadelphia. Mr. Markle makes his headquarters at 1409 Manhattan Building, where he can be found almost any time buried in work.

THE WEST CHICAGO STREET RAILWAY COMPANY will soon let contracts for the erection of an immense electric power house at the intersection of California avenue and Roscoe Boulevard to furnish the motive power for the trolley lines of the company, to be operated in connection with the Milwaukee avenue cable system. The structure will be one story and a half high, and will cover 100 x 125 feet of ground.

THE AMERICAN ELECTRICAL WORKS, of Providence, is one of the large houses of the country which has come to the conclusion that Western business justifies a branch office in this city. They now have handsome quarters at

241 Madison street, where Mr. T. E. Donohoe is in charge. Mr. Donohoe is busy getting things in shape and is ready to receive friends of the company.

THE JENNEY ELECTRIC MOTOR COMPANY, of Indianapolis, Ind., has been reorganized on a very strong financial basis. It is now arranging for the erection of new works in the city of Indianapolis to cover many acres of ground, as its business has recently grown to huge proportions. Western Manager Goode reports business excellent considering the times, and the new fortunes of the company will be welcomed by its thousands of friends.

THE ABENDROTH & ROOT MANUFACTURING COMPANY has opened an office at 1422 Monadnock Building, and placed it in charge of Mr. George K. Hooper. This firm is well-known in the West by reason of its famous water tube boiler; but it appreciates that to have a manager on the ground will materially assist in closing many of the large orders that will soon be placed in this vicinity. Mr. Hooper will find many words of praise for his boiler throughout the West.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, whose offices on the fifth floor of the Monadnock are the busiest in the building, seem to be overwhelmed with business in the shape of new exchanges and orders for private line telephones. Manager Stitch and President Keelyn are always at their desks, while Treasurer Kennedy is busy with the books. Its factory on the West Side is overcrowded with work, and it seems to be on the increase. One of its latest successes was the securing of a large order from the Metropolitan "L" road, which has ordered an equipment for every station on its line.

CANADIAN NOTES.

OTTAWA, July 14.

TORONTO.—The street railway revenue shows an increase in spite of the hard times. The total earnings for June were $88,335, of which the city's share was $7,066. In June, 1892, the city's share was $6,729, and in June, 1893, $6,039.

WINNIPEG.—The Judicial Committee of the Imperial Privy Council have given judgment in the case of the Winnipeg Street Railway Company vs. the Winnipeg Electric Street Railway Company and the city of Winnipeg, affirming the judgments appealed against.

MONTREAL.—The Railway Committee has passed the contested bill respecting the Montreal Park & Island Railway Company, and made the capital stock $1,000,000, against the protest of Mr. Williams, the promoter of the bonus for the road, who has $125,000 of stock given him for his services.

OTTAWA, ONT.—At a meeting of the newly appointed directors of the Electric Street Railway, J. W. McRae was elected president, and Mr. G. P. Brophy vice-president. After the Governor-General assents to the bill for the amalgamation of the two roads, the shareholders of each will be called to elect a new board of directors and reorganize.

MONTREAL.—Electrical railway construction is making wonderfully rapid headway on the island of Montreal. Last fall the Montreal and Island Park Co. built a road to the Back River, a distance of six miles, and now the same system is being extended round the mountain to Cote des Neiges, the intention being to further extend the railway to Notre Dame de Grace, and connect with the Montreal Street Railway at Cote St. Antoine.

OTTAWA, ONT.—The agreement between the corporation and the amalgamated lighting companies for the lighting of the city for ten years after the expiration of the present contract has been signed by Messrs. G. P. Brophy, president; D. R. Street, secretary, and W. Y. Soper, director, of the Chaudiere Electric Lighting Company; Messrs. E. H. Bronson, president, and G. B. Pattee, director, of the Standard Electric Lighting Company, and City Clerk Henderson.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, July 4, 1894.

ELECTRIC LIGHTING AND THE FACTORY ACTS.—At the Westminster Police Court recently there was a batch of prosecutions against the owners of several small workshops for permitting women to work on their premises after the authorized time, and not providing sufficient cubic space. One of the defendants made a somewhat ingenious pleading, which was to the effect that as he had adopted the electric light, which did not vitiate the atmosphere, he considered that overtime on his premises could not be injurious to the workers from the respiratory point of view. This ingenious pleading was not, however, of any avail.

HORSE TRACTION AS AN AID TO ELECTRIC TRACTION.—At a recent meeting of the Association of Municipal Engineers a paper was read by Mr. R. Hammond on the subject of electric traction, and it must be confessed that although for the most part it contained nothing but generalties, there was at least one startling idea. Mr. Hammond advocated the combination of the electric lighting with the electric traction business. He pointed out that for a few hours every day the heavy traction load and the heavy lighting load would coincide. He made several suggestions as to how this difficulty might be overcome, and ended up by pointing that the best way out of the difficulty was to temporarily horse the cars.

INDUSTRIAL EDUCATION AND TRADE-UNIONISM.—The Technical Education Board recently appointed by the London County Council has instituted a series of conferences between the members of the board and representatives of the industries of the Metropolis, with the laudable object of discovering exactly what it is the British workman requires in the way of technical or industrial training. There was a general consensus of opinion amongst the delegates of the engineering and allied trades that the law should oblige employers to afford their apprentices time during the day to attend classes for systematic instruction in the principles of their craft; that these classes should be in touch with the trade; that the instructors should be practical workmen; that no one but those actually engaged in the trade should be allowed to attend these classes. The demand that the technical classes should be in touch with the trade generally took the form that they should be controlled by the trades-unions, and the demand that no one but those actually engaged in the trade should be allowed to attend the classes went so far as to exclude experienced gas fitters and house carpenters from adding to their earning powers by obtaining that modicum of electrical knowledge necessary to make them efficient wiremen. Up to the present the average electrical wireman may, for aught we know, be a very efficient electrician, but he certainly is uncommonly clumsy in getting about the house, and in that respect an electrically competent gas fitter or carpenter would probably make a much better workman than the so-called electric light wireman.

News of the Week.

TELEGRAPH AND TELEPHONE.

NEWBERNE, N. C.—Address P. H. Pelletier regarding a new telephone exchange to be established.

SALISBURY, N.C.—A franchise for constructing a telephone system has been granted to J. Allen Brown and others.

DANBURY, CONN.—Hoyt & Russell, manufacturers of telephones, are reported to have dissolved partnership.

AMERICUS, GA.—The Bell Telephone Company will construct a line to Albany, Ga. Jeff. D. Peacock is manager of the exchange.

SHELBYVILLE, IND.—Franchises have been granted to the Mutual Telephone Company, in which George C. Platt and D. C. Yowell are interested.

CHESTERTOWN, N. Y.—The Chestertown Telephone Company has built a line to the Palisades, a new hotel on the shores of Brant Lake, kept by Smith Barton. This company is about to extend its line to Warrensburgh. All the hotels at Fieand's Lake are connected with Chestertown.

PHILADELPHIA, PA.—A number of business men visited the Bullitt Building and inspected the workings of the automatic switchboard of the Mutual Automatic Telephone Company, which by ordinance of Councils has been given authority to cover the entire city by the new system.

ELECTRIC LIGHT AND POWER.

WILLIAMSVILLE, ILL.—The citizens are agitating the question of an electric lighting plant.

DALLAS, TEX.—Judge T. F. Nash may be written to in regard to an electric wiring contract.

LOS ANGELES, CAL.—Franchises have been granted to Chas. Walton to put in an electric plant.

ELBERTON, GA.—Address D. A. Matthews regarding the establishment of an electric power plant.

NORWOOD, PA.—Address G. C. Skelton regarding electric lighting contract to be given out August 1.

FRONT ROYAL, VA.—The Council is considering the matter of establishing a municipal lighting plant.

LAFAYETTE, COL.—A franchise has been granted to J. S. Spencer to furnish light, heat and power to the town.

CAPE GIRARDEAU, MO.—Franchises have been granted to R. W. and T. W. Gannon to put in an electric light plant.

ESTHERVILLE, IA.—N. B. Egbert, city clerk, can be addressed regarding construction of an electric light plant.

PAWNEE CITY, NEB.—A movement is on foot to establish an electric light plant in connection with the water works.

MARSHALL, MINN.—The vote to bond Marshall for $25,000 for electric light and water bonds was carried by 73 majority.

KALAMAZOO, MICH.—Address Chauncey Strong, city clerk, regarding the construction of an electric light plant for the city.

CLARKSBURG, W. VA.—Address D. P. Morgan, president Traders' Company, concerning the installation of an electric light plant.

GONZALES, TEX.—F. R. Starr, Jr., may be addressed regarding a 500-light dynamo to be put in by the Goliac Water Power Company.

WELLS, MINN.—The village has called a special election for July 24 to vote on the question of issuing $20,000 electric light and water bonds.

BALTIMORE, MD.—The Viaduct Manufacturing Company is about to erect a new electrical plant to replace the one recently burned at Relay, Md.

SHAWANO, WIS.—An ordinance is before the Council for establishing an electric plant. Final action will be taken July 30. A. C. Weber is city clerk.

YATES CITY, ILL.—A franchise has been granted to the Elmwood Electric Light Company to establish an electric plant. T. J. Knightlinger is city clerk.

KEY WEST, FLA.—The Key West Gas and Electric Light Company has increased its capital stock from $75,000 to $250,000 for the purpose of enlarging its plant.

CARROLL, ILL.—An ordinance has been passed granting ten years franchise to C. P. Woodworth to operate an electric light plant. Aaron Smith is city clerk.

BALTIMORE, MD.—During the Summer a new 12 h. p. electric motor will be put in the Baltimore Colored Manual Training School, on Fremont avenue, near Lombard street.

WASHINGTON, D. C.—Horace S. Cummings, acting for a syndicate, is reported as having purchased a $14,000 tract of land on which a large electric plant will be erected.

CROWLEY, LA.—The Council has secured O. H. Landreth to prepare plans and specifications for an electric light and water plant. The contract will be let as soon as the specifications are ready.

NEW YORK CITY, N. Y.—The United Electric Light and Power Company, 108 Fulton street, will erect a one-story brick electric light station at No. 407 to 419 East Twenty-eight street, to cost $80,000

ALBERT LEA, MINN.—The electric light and power house, C. G. Edwards manager and principal owner, has been burned. The dynamos were entirely destroyed. The loss is $8,000, with no insurance.

SHELBYVILLE, KY.—The Shelbyville Water and Light Company is in the market for engines, dynamos, apparatus, lamps, poles, wiring, etc., of the electric light plant to be constructed by that company.

WAKEFIELD, MASS.—A meeting will be held July 16 for the purpose of providing for an issue of bonds to the amount of $144,680, to be used for the purchase of the Citizens' Gas and Electric Company's plant.

HENDERSON, MINN.—Sealed proposals for an electric light plant for the city of Henderson, Sibley County, will be received until August 1, 1894. Plans and specifications on file with the city clerk J. J. Mohre.

NAPOLEON, O.—Sealed proposals will be received until July 24 for electrical

apparatus, one 60-light dynamo, and one 1,500 incandescent light dynamo, including a first-class electric light plant. J. Koller is city clerk.

The Electric Railway.

SAN FRANCISCO, CAL.—Address J. A. Russell, city clerk, regarding street railway franchises.

SKOWHEGAN, ME.—The town has voted $10,000 in aid of an electric road from Norridgewock to this place.

DELAWARE, O.—A franchise has been granted to the Delaware Electric Railway Company to extend its lines.

ROME, N. Y.—The Rome City Street Railway Company is about to change its system to electric motive power.

MONTGOMERY, ALA.—The Montgomery Street Railway Company has been granted a franchise to extend its lines.

RUTHERFORD, N. J.—It is proposed to construct a trolley line from this place to connect with the main line to Jersey City.

PROVIDENCE, R. I.—The Union Railroad Company proposes to extend its line from Exchange to Smith's Hill, by way of Francis street.

LEWISTON, ME.—The Lewiston & Auburn Horse Railroad Company has decided to adopt electricity as a motor power on its lines at once.

COLUMBUS, GA.—The North Highlands Railroad Company, operating an electric railway, has been granted a franchise to extend its lines.

PHILADELPHIA, PA.—Charles McCaul is receiving bids for the new power house of the Electric Traction Company, which is to be a large structure.

LEWISTON, N. Y.—The Lewiston & Youngstown Electric Railroad will be reorganized and will build an electric railroad from Lewiston to Youngstown.

DRACUT, MASS.—The Lowell, Lawrence & Haverhill Street Railroad Company has received a permit to construct an electric road within the city limits.

CUMBERLAND HILL, R. I.—The Woodsocket Electric Power and Machine Company has asked for permission to construct an electric road from Manville to Cumberland.

WASHINGTON, D. C.—The Alexandria & Mount Vernon Electric Railway has permission to construct an electric road through Arlington reservation to this place.

WASHINGTON, D. C.—The Eckington & Soldiers' Home Railroad has been granted permission to put down an underground electric system, invented by Malone Wheless.

BALTIMORE, MD.—The Baltimore, Conton & Point Breeze Railway Company contemplates constructing an electric road from Battle Monument to the eastern city limits.

GUTHRIE, OKLA.—Address Charles Fitzgerald in regard to a street railway, for which he has been granted a franchise, but for which the equipment has not yet been purchased.

RUTHERFORDTON, N. J.—Jonah White writes: "It is now an assured fact that an electric railway will be built from Rutherfordton to Chimney Rock, a distance of seventeen miles.

HARTFORD, CONN.—An electric railway between this city and Rockville before the end of the year is assured, and Manchester will be connected with Hartford by an electric line by October 1.

ST. AUGUSTINE, FLA.—Address Charles Sperry, superintendent St. Augustine Railroad and Steamboat Company, 12 West Thirty-first street, New York, concerning an electric railway to be constructed.

SAND LAKE, N. Y.—It is now an assured fact that an electric road is to be built between Sand Lake and Troy. J. K. Averill has been appointed a committee to interview the stockholders in regard to the stock, etc.

KNOXVILLE, TENN.—It is reported that Messrs. Eperandieu and Cramer, representing the Niagara Power and Development Company, are endeavoring to form a company to build a five-mile electric road to Spring Place.

BLOOMFIELD, N. J.—A petition from the North Jersey Street Railroad Company for a franchise for an electric line from the Newark passenger line to the Monticello line was referred to the Committee on Law and Franchises.

RUTLAND, VT.—A meeting of the stockholders of the new street railway company, to be known as the City Electric Company, was held, and following directors elected: E. A. Morse, E. M. Woodruff, J. E. Creed and others.

LANCASTER, PA.—The Pennsylvania Traction Company, operating the entire electric railway system of Lancaster County, has decided to extend its lines through the county. The contract for the work will be awarded next week.

KEY WEST, FLA.—John J. Philbrick, of Key West, is completing arrangements in New York City for the transfer of the street railway property to the Key West Electric Street Railway Company. Horse power will be superseded by electricity.

CRISFIELD, MD.—The Somerset Electric Light and Railway Company was chartered by the last Legislature with Thomas S. Hodson, of 6 East Lexington Street, Baltimore, as president. About two and one-half miles of road will be built.

NORTHAMPTON, MASS.—Business has so rapidly increased on the electric railroad that the company is now to petition the aldermen for the privilege of double tracking the road on Main street. The line will be built this year if request is granted.

BRISTOL, CONN.—The directors of the Bristol & Plainfield Tramway Company and the borough committee have reached an agreement in regard to the construction of the proposed line. The incorporators are N. E. Pierce, Treadway & Muzzy, of Bristol, and others.

BALTIMORE, MD.—The Maryland Central Railroad Company is reported to be seriously considering the operation of its line by electricity. In this connection it is stated that the Baltimore & Ohio Railroad trains will be run through the belt tunnels by powerful electric motors.

BRADFORD, PA.—The city councils passed the ordinance granting the Bradford Electric Street Railway Company exclusive right and privilege to construct and operate a street car line from the American House, in East Bradford, through the Third and Fourth Wards, etc.

Miscellaneous Notes.

PROFESSOR HELMHOLTZ, as we go to press, is reported by cable to be dying.

THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK has issued the report of its eleventh annual meeting, held at Rochester, September 19, 1893. Only one paper was read at his meeting, "The Return Circuit of Electric Railways," by T. J. McTighe, but this with its discussion is a valuable contribution to the subject.

MR. JOHN B. M'CORMICK, the well-known Holyoke, Mass., manufacturer of turbines, has written a pamphlet entitled "Reasoning from Cause to Effect," and containing his opinions on the economic and industrial situation. Mr. McCormick is a firm believer in free trade, and this pamphlet is a remarkable contribution to the subject.

KILLED BY LIGHTNING.—Two men were recently killed at the Norfolk Navy Yard by lightning under peculiar circumstances. A number of men had sought shelter beneath the steel cruiser Raleigh, which lay in dry-dock there, when suddenly two of the men fell dead and others were knocked senseless by an electric shock, which was not felt by the officers on the deck. All the compasses were affected, and the vessel was magnetized.

FULL OF ELECTRICITY.—A young man employed at the Edison Lamp Works, Harrison, N. J., recently received a severe shock from an electric current, rendering him unconscious, in which state he remained, notwithstanding the efforts of physicians to restore him. It was finally decided by the doctors and an aunt of the young man that his body was full of electricity, which if removed would permit him to recover. An insulated wire was therefore grounded to a water pipe and a wet sponge at the other end applied to the body of the young man, when, to the delight of the aunt and the medical attendants, he regained consciousness, and a new principle in electro-therapeutics was established. What the effect of sponging alone would have been we are unfortunately left in the dark.

Trade and Industrial Notes.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has received an order from the United Electric Light, Heat and Power Co., of New York City, for an iron roof, with anti-condensation corrugated iron roof covering, for a switch board building.

THE UNITED STATES HEADLIGHT COMPANY, Utica, N. Y., has made arrangements with I. A. Williams & Co., Utica, N. Y., and Chicago, Ill., to act as one of its agents for the sale of its locomotive, electric, cable and motor car and other headlights.

THE JONES MANUFACTURING COMPANY, 1820 and 1822 Mechanic street, Norwalk, Conn., manufacturer of typewriter supplies of every description, claims that its factory is one of the most complete in the United States, and that every month shows a large increase in business, notwithstanding the hard times.

ARMATURE WINDING.—We have received a communication from the Chelsey Manufacturing Company, of Hoboken, N. J., claiming that the system of spiral winding, or angular advance of section, described in these columns as devised by S. W. Rushmore, was invented and patented by Mr. George Hoare, of Brooklyn; that it has also been used by the Excelsior Electric Company, and that it is only applicable to armatures wound with a single turn of wire.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, 572-578 First Avenue, New York City, has received a very flattering letter from Hilton, Hughes & Co., expressing the greatest satisfaction with the 500 incandescent arc lamps installed in their large establishment. Hilton, Hughes & Co. state that the lamps are not only sightly in appearance, but the light is absolutely steady and agreeable, and particularly well adapted to show off goods like theirs; in fact, that the lighting is beyond criticism.

"MODERN TURRET LATHE PRACTICE" is the title of a pamphlet issued by the Gisholt Machine Company, Madison, Wis. The pamphlet gives illustrations taken from actual practice of some of the uses to which the company's turret lathes are put, and it is the intention to issue it monthly in the belief that the range of application of the turret lathe is so large, and that many of the most successful operations are so different from accepted practice, that the publication will be welcomed by superintendents, foremen and proprietors of manufacturing machine shops.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Indiana, has issued a 38-page general catalogue of its various electrical porcelain manufactures and the Laclede and Hercules carbon batteries. Unlike other porcelain and carbon manufacturers, this firm gives undivided attention to the making of electrical goods, and therefore naturally pays particular attention to the electrical properties of the material. The porcelain, we learn from the catalogue, is burnt with natural gas, the temperature being 4,000 degrees Fahr., thus producing an excellent insulating glaze, and the carbon used in the batteries is also made from natural gas.

THE ELECTRIC APPLIANCE COMPANY, Chicago, appreciating the fact tha users of colored and frosted incandescent lamps have undoubtedly frequently suffered considerable inconvenience from inability to get their orders for fancy goods filled promptly from stock, has perfected plans for frosting and coloring lamps of all kinds in Chicago and established a coloring room for doing this work, and can now furnish colored and frosted lamps promptly on receipt of orders. By the use of improved coloring compounds and methods of treating results have been secured in colored and frosted lamps, fully equalling those obtained from genuine colored and frosted glass. Customers will undoubtedly show their appreciation of prompt delivery on these goods.

THE ALTOONA MANUFACTURING COMPANY, Altoona, Pa., reports the following orders received during June: One 280-h. p. engine, for the Akron Street Railway Company, of Akron, O., to be direct-coupled to a 250-h. p. generator built by the Walker Manufacturing Company, of Cleveland O.; one 150-h. p., inclosed type self-oiling engine for the Watson Mining and Manufacturing Company, of Monongahela City, Pa., for an electric mining and haulage plant; one 65-h. p. inclosed type, self-oiling engine for the Lyceum Theatre, Philadelphia; one 175-h. p. standard centre-crank engine for the Freeport Electric Com-

pany., Freeport, Ill.; one 65-h. p. inclosed type, self-oiling engine for Knight Bros., Fayette, Ia. There is considerably more inquiry and with a settlement of the railroad strike it is believed that a substantial improvement in business will result.

THE WENSTROM APPARATUS, for which Henry B. Oakman, 136 Liberty Street, New York, is the general eastern agent, is meeting with exceptional success, and the following sales for the past month are reported: Two 30 k.w. generators for the St. James Hotel, N.Y.; one 35 h.p. motor to the American Grocery Company, N. Y.; one 50 and one 30 kw. to the Empire Hotel, N. Y.; one 30 kw. to the Stevens Apartment House, N. Y.; one 10 kw. to the Adams House, N. Y.; one 30 kw. to the Lake View Brewing Company, Buffalo, N. Y.; two 50 kw. to the Gould Coupler Company, Depew, N. Y.; one 25 kw. to Earle's Hotel, Richfield Springs, N. Y., and one 15 kw. to the Co-operative Brewing Company, Buffalo, making a total of over 7,000 lights capacity.

THE "ACME" PORTABLE VOLTMETER.—Queen & Co., of Philadelphia, have for months past held back from the market a new type of portable voltmeter for both alternating and direct current circuits, in order to give it a thorough time test. They are now satisfied that the instrument is thoroughly adapted to laboratory as also station measurements, and are preparing to manufacture it in sufficient quantities to meet the large demand which seems assured so soon as the merits of the voltmeter become known. It operates on the "hot-wire" principle and is absolutely free from hysteresis error, thus being correct for alternating circuits of any frequency. It is dead beat without a mechanical brake—a most important feature—and is the most compact reliable instrument of its class made. Twenty different ranges cover potentials from two volts to three thousand, and by means of a special interchangeable adapter which fits the Edison, Thomson-Houston or Westinghouse systems, measurements can be made very rapidly. The "Acme" Voltmeter received the highest World's Fair award because "It possesses high sensibility over the entire scale, and its zero is not affected by changes of temperature. The instrument is unusually compact and portable." The instrument was fully described in The Electrical World of March 3, 1894.

P. AND B. BUILDING AND INSULATING PAPER.—The validity of United States Patent No. 378,520, under which this paper is manufactured, has been established in case of the Standard Paint Company vs. Henry J. Bird and James L. Reynolds, where after an exhaustive litigation extending over four and a quarter years, and after consideration of a printed record of upward of 1,000 pages, the Circuit Court of the United States for the District of New Jersey, on July 5, 1894, made and entered a decree adjudging that the patent was valid and had been infringed by the defendants and directing an injunction against the defendants and an accounting. The opinion of the court, written by George M. Dallas, Circuit Judge, holds that the patent covers any paper coated with a solid residuum obtained from the distillation of petroleum, and that the manufacture and sale of any substantially similar paper is an infringement of the patent. The coating mentioned, and which, as established by the evidence in the case and by decree of the court, was first used by this company, and protected by the United States patent referred to, makes an odorless, water, acid and alkali proof and thoroughly insulating paper, as is well known. The court holds that papers possessing these essential characteristics, which were new up to the time of their introduction under the name of P. & B., made by others, are a violation and infringement of the complainant's rights.

EDWARD F. AUSTIN, contracting engineer and manufacturers' agent, 95 Fifth Avenue, Pittsburgh, Pa., has just completed the installation of a 50 h. p. M. A. Green improved automatic engine to operate a 500-light Westinghouse dynamo in the Christ M. E. Church of that city. The plant possesses more than usual interest on account of its being one of the first to be installed in a church for lighting purposes. The following sales of M. A. Green engines in that vicinity are also reported: One 80 h. p. to the New Castle Car Manufacturing Company, of New Castle, Pa.; one 50 to 180 h. p. to Jones & Lockwood, Pittsburgh, for the operation of electric cranes, with which their mills have been equipped; two 60 h. p. for the McIntosh-Verner Building, Pittsburgh; one 150 h. p. to the Watson Mining and Manufacturing Company, of Monongahela City, Pa., and one 12x14 to the Lorch-Eble Machine Company, of Pittsburgh.

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OPEN AND CLOSED CIRCUIT CELLS.—The Hayden carbon porous cup No. 1; the Hayden carbon porous cup No. 2 cell; a Leclanche clay porous cup cell; a standard Fuller cell; a No. 2 Fuller cell; a single cylinder carbon cell; a double cylinder carbon cell. All reliable and efficient, and at prices lower than ever. THE HAYDEN-BOOKER MANUFACTURING COMPANY, 2140 DeKalb street, St. Louis, Mo.

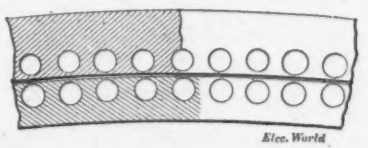
Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 10, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

REISSUE 11,428. ELECTRIC SIGNALLING APPARATUS; J. P. Coleman, Swissvale, Pa. Application filed December 5, 1893. In an apparatus for connecting a signal with its primary actuating mechanism, the combination, with the signal and its connecting rod, of a pivoted lever which forms one of the mechanical connections between the signal and the actuating mechanism, the lever being movable on its pivot into and out of connection with the signal connecting rod, and an electromagnet which acts on the lever to hold it in connection with the signal connecting rod.

522,580. DYNAMO ELECTRIC MACHINE; L. Bell, Lynn, Mass. Application filed September 19, 1892. An alternating current motor having the adjacent faces of its armature and field magnet poles provided with coil chambers,



NO. 522,580—DYNAMO ELECTRIC MACHINE.

teeth and channels of such shape and so arranged that the reluctance of the magnetic path through them is uniform at all positions of the moving parts. (See illustration.)

522,581. CONTROLLER FOR; ELECTRIC MOTORS; J. B. Flood, Lynn, Mass. Application filed December 18, 1893. A switch adapted to start the motors in one direction and regulate their movement from rest to highest speeds, and in the reverse direction to start and cause them to operate at lowest speed.

522,597. ELECTRIC SWITCH; J. Hutchinson, New York, N. Y. Application filed June 14, 1893. This comprises a tube, an insulating saddle, stationary contacts carried thereby, a spindle passing through the saddle, and a movable contact-bearing part carried by the spindle.

522,621. COMBINED HANGER AND AUTOMATIC SWITCH FOR TROLLEY WIRES; R. Schefbauer, Paterson, N. J. Application filed July 15, 1893. This comprises a body of insulating material, two levers attached thereto, a hanger from which the insulating body is suspended, and two sets of contact jaws on the hanger.

522,632. CIRCUIT CLOSING DEVICE; P. J. Walsh, Jr., Philadelphia, Pa. Application filed May 3, 1894. This comprises a supporting case plate, a tongue pivoted thereto, a spring acting on the block, and terminals, the point of contact of the terminals being so disposed that in making contact they will simply abut without sliding friction.

522,655. CONDUIT RAILWAY TROLLEY; J. L. Creveling, Auburn, N. Y. Application filed April 5, 1894. This consists of a depending plate in combination with trolleys supported on either side thereof by a pair of pivoted arms.

522,664. ELECTRIC DISTRIBUTION BOX; O. D. & M. A. Kleinsteuber, Milwaukee, Wis. Application filed April 5, 1894. This comprises a box; an insulating base therein, and a series of pairs of contact sections having arms extended through the insulating base to be electrically connected with strands of cables.

522,670. DANGER SIGNAL FOR RAILWAY CROSSINGS; M. W. Parrish, Detroit, Mich. Application filed October 30, 1893. This comprises a signal, electrical actuating mechanism therefor, and contact devices operated by a passing train to set the signal in operation.

522,674. ELECTRIC METER; G. A. Scheeffer, Peoria, Ill. Application filed April 12, 1894. The combination of a stationary multipolar magnet, provided with three polar or magnetic surfaces and a metallic cylindrical rotating armature magnetized thereby.

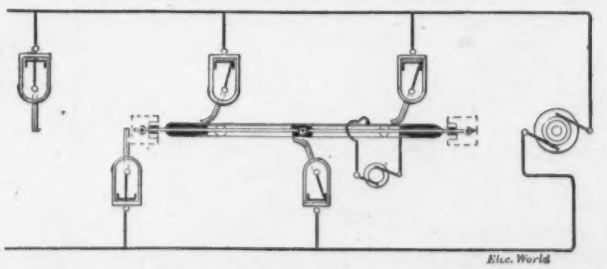
522,680. ELECTRIC ARC LAMP; M. S. Okun, New York, N. Y. Application filed September 1, 1892. The combination of a carbon carrying rod, a lever, a sliding rod carried by the lever to support the first rod, and a counterbalance to equalize the weight of the lever.

522,690. ELECTRIC LAMP HOLDER; M. P. Meyer, Rochester, N. Y. Application filed February 27, 1894. The combination of an insulated holder, a lamp guard constructed of wire, and a shade on the holder.

522,707. TELEPHONY; F. R. Colvin, New York, N. Y. Application filed May 22, 1894. This comprises a telephone in permanently closed relation to the line terminals, and a call receiving instrument in shunt relation to the telephone the shunt including contacts electrically bridged by a contact piece carried by the telephone and removable therewith to open the shunt when the telephone is removed.

522,709. CONTACT SHOE FOR ELECTRIC LOCOMOTIVES; J. J. Green, Boonton, N. J. Application filed July 5, 1893. This consists of separate end pieces, side strips of flexible material secured thereto, and a flexible or yielding central bar to which the insulated end piece are loosely attached. (See illustration.)

522,710. CONTACT BAR FOR ELECTRIC LOCOMOTIVES; J. J. Green, Boonton, N. J. Application filed October 9, 1893. This consists of flexible side



NO. 522,709—CONTACT SHOE FOR ELECTRIC LOCOMOTIVES.

strips connected together at or near their ends by loose or sliding connections and rigidly connected at or near the middle.

522,711. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; J. J. Green, Boonton, N. J. Application filed October 9, 1893. A shoe for electric railways having plates or strips with side contact faces arranged in or about the same vertical plane, one above the other.

522,718. ELECTRIC HEATER; H. W. Leonard, New York, N. Y. Application filed March 22, 1893. A heater having a thinly insulated conductor imbedded in and completely surrounded by a closely applied mass of metal.

522,724. ELECTRIC SYNCHRONIZER FOR CLOCKS; L. Von Orth, Berlin, Germany. Application filed May 6, 1892. The combination of a pendulum, a

verge rod provided with a pivoted lever in separable connection with the pendulum, an armature lever, an electromagnet, and a cam adapted to control the motion of the lever.

522,727. ELECTRIC LAMP LIGHTER: J. C. Chambers, Detroit, Mich. Application filed February 10, 1894. This comprises a rigid support, a framework pivoted thereto, a swinging lamp, a contact device carried by the framework, and a contact device carried by the lamp.

522,733. ELECTRIC DOOR OPENER: H. F. Keil, New York, N. Y. Application filed January 30, 1894. The combination of magnets, an insulating plate, an armature, a locking dog shaft having one end conically bored and the other tapered and held in place, and a lock latch having a spring.

522,735. ELECTRIC ARC LAMP; P. Kirkegaard, Brooklyn, N. Y. Application filed September 28, 1893. A carbon holder consisting of a U-shaped yoke pivotally connected with the end of the carbon rod, in combination with two jaws pivoted respectively to the arms of the yoke. (See illustration.)

522,745. INSULATING COMPOSITION; J. L. Truslow, Summit, N. J. Application filed July 27, 1893. A composite mass for insulating purposes, consisting of ground cork and infusorial earth, and a binder of rosin.

522,757. DEVICE FOR PREVENTING RAILROAD COLLISIONS; C. Holtmann and N. Schmidt, Pittsburg, Pa. Application filed November 14, 1893. This comprises a track battery for each "block" and an instrument in connection with the air brake which will set the brakes when any two trains enter the same block at the same time.

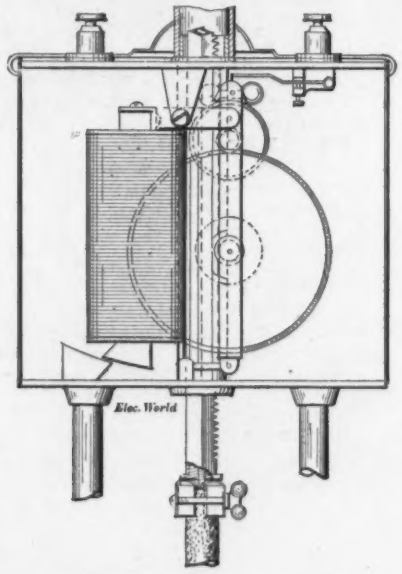
522,790. ELECTRIC ARC LAMP; E. F. Gwynn, Delaware, Ohio. Application filed April 28, 1893. This comprises a carbon rod, gearing for feeding the same mounted on a movable lever controlled by a magnet in the main circuit, and a friction clutch arranged in the gearing, and a stationary device adapted by the movement of the lever to operate the friction clutch and thus disengage the carbon rod from the gearing to permit the carbon rod to feed independent of the gearing.

522,820. MEANS FOR REGULATING ALTERNATING CURRENT MOTORS; E. M. Bentley, Boston, Mass. Application filed Apil 17, 1893. The method of changing the relative phase periods of primary and secondary alternating currents which consists of passing such primary current through the primary of a transformer and shifting the points of connection of the secondary and the line relatively to the polarity of the primary. (See illustration.)

522,834. ELECTRIC LOCOMOTIVE; E. Hopkinson, Manchester, England. Application filed July 21, 1891. The combination with the driving axle of the motor having its armature built upon an axle, and its magnets and polar pieces suspended beneath the axle from journals thereon.

522,835. ELECTRIC CRANE; E. Hopkinson, Manchester, England. Application filed July 21, 1888. The combination with the motor shaft serving as an axle, traveling wheels and lifting barrel, of clutches by which the axle can be connected to or disconnected from the traveling wheels and be connected to or disconnected from the lifting barrel.

522,836. GALVANIC BATTERY; L. F. Johnson, Poughkeepsie, N. Y. Application filed April 7, 1894. An electrolyte composed of sulphuric acid, water



No. 522,735—Electric Arc Lamp.

having chromate of calcium dissolved therein, and nitric acid, the said components being unmixed and arranged in the cell in the order named.

522,837. CURRENT SEPARATOR; L. F. Johnson, Poughkeepsie, N. Y. Application filed April 7, 1894. This comprises connections for the main circuit, a common connection for one side of the local circuit to one side of the main circuit, independent connections for the other side of the local circuits, and means for interposing resistance between the connections for the main circuit and at the same time connecting in one or more of the local circuits, whereby the local current receives the shunt from said resistance.

522,841. ELECTRIC BELT: W. E. J. Lawlor, Portland, Ore. Application filed September 14, 1893. This comprises a copper plate bent into a link and provided with a slot and tongue, a slide fitted to the plate, a perforated zinc plate and a porous septum.

522,844. TOLLEY EAR; C. A. Lieb, New York, N. Y. Application filed April 12, 1894. A trolley ear having a sheet metal portion with an upwardly extending fin or fold and a cast metal bolt portion secured to the fin or fold.

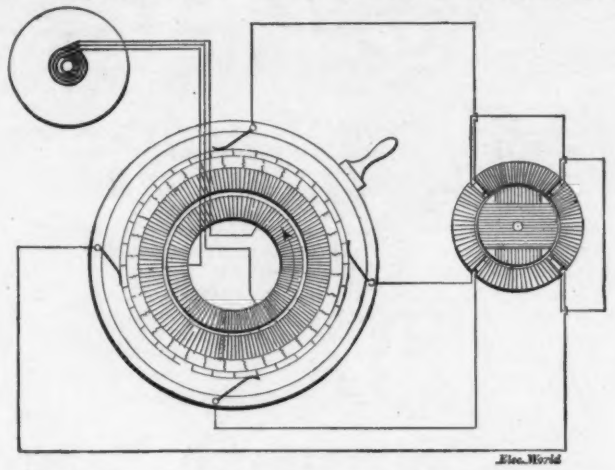
522,845. TROLLEY WHEEL; C. A. Lieb, New York, N. Y. Application filed April 12, 1894. A trolley wheel having a central core of copper or bronze and provided with steel flanges having stiffened edges.

522,851. MOTOR SAFETY DEVICE; A. W. K. Peirce, Plymouth, Mass. Application filed October 29, 1892. The combination of a dynamo with a shunt around its field circuit comprising a non-inductive resistance, a switch controlling the main circuit of the machine, and an auxiliary switch in the shunt circuit controlled by the main switch.

522,859. INSULATED ARMATURE COIL; J. H. Shugg, Boston, Mass. Application filed April 21, 1894. An electric coil the conductors of which are bound together and insulated by two layers of tape between which is interposed an oiled fabric.

522,865. CURRENT INTERRUPTER FOR HIGH POTENTIAL CIRCUITS; E. Thomson, Swampscott, Mass. Application filed February 6, 1893. The combination with two separable terminals of a spring actuated drum connected with one of said terminals and an electromagnet adapted to disconnect said terminals.

522,892. TELAUTOGRAPH; E. Gray, Highland Park, Ill. Application filed March 8, 1893. The method of transmitting and recording a character by the movements of a transmitting pen and a receiving pen by transmuting the movements of a transmitting pen into electric pulsations, sending to line



No. 522,820—Means for Regulating Alternating Current Motors.

in the reversing circuit a current of changed strength upon reversal of the transmitting pen in one or two crosswise directions of motion, and a current of changed polarity upon reversal in the other of the two crosswise directions of motion of the transmitting pen, thereby reversing the movement of the receiving pen in said two directions respectively.

522,893. TELAUTOGRAPH; E. Gray, Highland Park, Ill. Application filed February 27, 1894. The combination in a telautograph of a power mechanism, a torsional spring, and means for maintaining constant the tension of the spring, a reversing mechanism and a receiving pen.

522,894. CLOSED CONDUIT FOR ELECTRIC RAILWAYS; C. I. Greer, Washington, D. C. Application filed April 16, 1894. This comprises a slot cover, composed of a series of plates of rigid material having central-depending webs, which are pivotally linked together.

522,896. HANGER FOR ELECTRIC LAMPS; H. C. Henley, St. Louis, Mo. Application filed July 27, 1893. This comprises an externally threaded pipe, an internally threaded shell having a chamber into which the pipe discharges moisture, and an annular insulator fitting upon the pipe and within the shell out of reach of the moisture discharged from the pipe.

522,915. TROLLEY POLE; A. S. McBean, Montreal, Canada. Application filed April 10, 1894. A trolley wheel support composed of a metal section rigidly secured to the trolley pole, an adjusting platform and a frame piece, the latter carrying the trolley wheel or runner, with a swiveling connection between the adjusting platform and the frame piece.

522,919. ELECTRIC CIGAR LIGHTER; C. F. Reiff and H. Munk, Fremont, O. Application filed January 25, 1894. This comprises a wick tube, a contact point carried thereby, an over-balance tube hinged to the wick tube, a plug in the upper end thereof, an arm secured thereto and carrying a spring contact, and electric conductors connected with the tube and arm.

522,925. OPERATOR'S TELEPHONE CIRCUIT; T. C. Wales, Jr. Application filed December 2, 1893. This comprises a transmitting telephone in the local circuit, an induction coil having a single primary winding, included in the local circuit, and two secondary windings in circuit serially with the main line conductors, together with a branch extending from a point between them to earth, and a receiving telephone in a branch of the local circuit, shunting the primary windings.

522,934. ELECTRIC CIGAR LIGHTER; J. J. Eberhard and C. G. Schimkatt, Fremont, O. Application filed Sept. 25, 1893. This comprises a cross bar, depending hangers, a lamp pivoted to the lower end thereof, carrying a contact device adapted in the swinging of the lamp to engage with a contact device on the supporting framework of the lighter.

522,948. ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, N. J. Application filed October 3, 1892. This comprises a vibrating lever, a coil supported on one arm thereof, a fixed coil in inductive proximity to the movable coil, a means of equilibrating the movable coil and a spring opposing the vibration of the lever.

522,949. WATT METER; E. Weston, Newark, N. J. Application filed April 26, 1893. The combination of a fixed coil, a movable coil in the field of the fixed coil, a spiral spring opposing the movement of the movable coil, fixed resistance, a pole hanger and circuit connections.

522,950. ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, N. J. Application filed February 21, 1894. The combination with a wall or support, of an electrical measuring instrument movable about a pivot on the support, and means for adjusting the instrument so that its face may be disposed at various angles to the support.